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VIEWS, NEWS AND INTERVIEWS.

Alexander E. Outerbridge, Jr., in the course of an article in a recent number of the *Engineering Magazine*, said: "I believe that every novel machine possesses something of the personality of its creator. I believe, furthermore, that it is possible to trace through the machine, back to the inventor, a positive and continuing influence of his mind upon the mind of the operator."

An editor on the staff of one of the ELECTRICAL REVIEW'S contemporaries asked a little girl why the sun, which was setting in a blaze of red, was like his paper. He thought she'd say "Because it's read." But she didn't. Her answer was, "Because it hurts your eyes to look at it."

An interesting experiment of installing a telephone by trotting cavalry was recently successfully undertaken by some Prussian Uhlans between Berlin and Potsdam, says London *Engineering*. Two sets of one officer and two non-commissioned officers proceeded, in the early morning, respectively from Berlin and Potsdam. Each set was equipped with a complete telephone apparatus, which one of the men carried in a leather case on his chest, besides the requisite quantity of thin wire. The end of the wire was connected with the respective town's telephone station and the wire was, by means of a fork fixed at the end of the lance, thrown over the tops of the trees along the road. As each kilometre of wire was thus suspended, a halt was made, and it was ascertained whether there was connection with the station. A new kilometre of wire was then connected with the former, and on went the men. The two sets met at Teltow. The wires, having been respectively tested with their respective stations, were connected and telephonic connection between Berlin and Potsdam was established. The distance is about 20 miles and the whole thing was done in about four hours.

In certain towns of Germany the telephone is introduced by tobacconists as an additional attraction to customers. Any one who buys a cigar may, if he desire, speak over the tobacconist's instrument to a subscriber to the telephone service.

At the recent Detroit meeting of the American Society of Mechanical Engineers, this question was presented for discussion: "For filtering oil having very finely divided metallic particles in suspension, what have you found to be the best filtering material, either for one operation or in series?" A member replied that he had successfully used two pans, one placed above the other, and that the oil had been carried from the upper to the lower one by means of wicks.

A green conductor on a Brooklyn trolley car was asked by the company to explain why he didn't ring up fares. This is his report:

As I vas gomings on mine fiths treps upps at gorner of Busick & flushing strasse 10 peoples gots on mine cars they has tickets mit meroplian av. und I vas goming wit ridgewoods the elecris inspicters vas say told them stand on the gorner und vaits for car mit city lines.

The New Era in Railroading.

[*From the Boston News Bureau.*]

The great revolution which is occurring in the motive power of this country from steam to electricity, and the attention which is being directed to the gold-producing interest by reason of the world's scramble for that metal in recent years are attracting capital to the larger development of these enterprises.

Repairing Commutators With Litharge Paste.

TO THE EDITOR OF ELECTRICAL REVIEW:

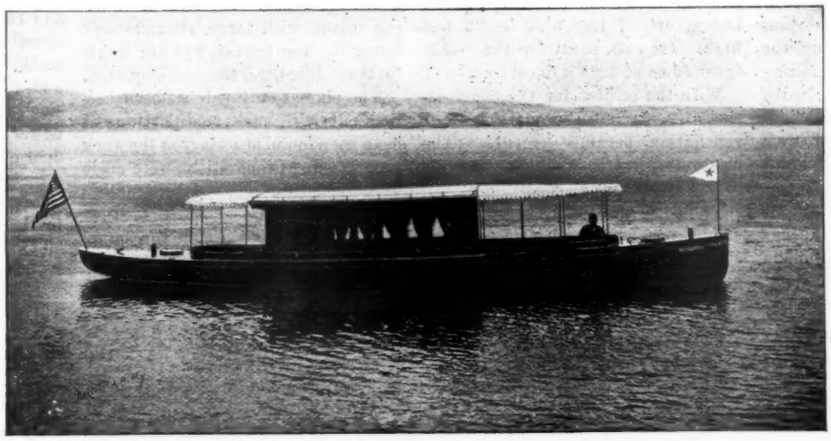
It may be of benefit to some of your readers to know that to repair either dynamo or motor commutators, where the mica is out, I have found the following excellent: Take litharge and mix it to the consistency of thick cream with glycerine, then apply to the cracks, completely filling them, allow to dry for 8 or 12 hours, then scrape off the top or rather file it off smooth and level with the commutator.

Yours truly,
CHAS. H. MINCHEW,
Taunton, Mass., June 28, 1895.

A new electric railway between Newark and Jersey City, N. J., was opened on June 30. The cars run through East Newark and across the Hackensack meadows on the old turnpike to the Cortlandt street ferry. It is a part of the Consolidated Traction Company's system.

Mr. J. J. Astor's Forty-Seven-Foot Electric Yacht.

The Electric Launch Company, of Morris Heights, New York city, are the builders of the electric yacht illustrated herewith. The boat was designed as a cruising yacht for Mr. John Jacob Astor, who is an enthusiast on electric navigation. This is but one of the several electric boats built for Mr. Astor by the Electric Launch Company under the supervision of Mr. J. C. Chamberlain, the manager and engineer of the company.



MR. JOHN JACOB ASTOR'S FORTY-SEVEN-FOOT ELECTRIC CRUISING YACHT.

The yacht illustrated is 47 feet long over all, the beam is seven feet six inches, the draught at the screws is two feet and one inch, the cabin is 12 feet long, the forward cockpit 11 feet long and the after cockpit six feet and six inches long. The hull is planked with cedar on oak frames and the decks are finished in natural wood. The cabin has head room of six feet and two inches and is finished in mahogany. The after part of the cabin on the starboard side is fitted up as a toilet room opposite which is a galley with shelves, drawers and a refrigerator. The furnishings of the boat are of an elegant and tasteful character, the metal work all being polished brass.

The electric equipment consists of twin screw apparatus, each motor being direct-connected to separate bronze shafts with ball thrust-bearings. The current supply to the motors is from independent groups of batteries and is regulated by two controllers placed near the steering wheel in the forward cockpit. The batteries of the well-known chloride accumulator type are located beneath the flooring and under the seats. There are 168 cells of battery, each having a capacity of 150 ampere hours at a 10-hour rate of discharge. The maximum horse-power developed in continuous work is 10, while 30 horse-power is available for a short

spurt. It requires from five to seven hours to recharge the batteries at a cost of about 84 cents an hour. A speed of about 15 miles an hour can be developed for a short distance and on a full battery charge, at the 10-hour rate of discharge, a trip of 75 miles can be made.

THE BALTIMORE BELT LINE TUNNEL.

A DESCRIPTION OF THE TUNNEL AND THE ELECTRIC POWER STATION WHICH FURNISHES CURRENT FOR THE BIG ELECTRIC LOCOMOTIVES.

The new Belt Line tunnel in Baltimore on the main line of the Baltimore & Ohio Railroad was undertaken to give this railroad a clear route through to the North. Previous to its completion all trains on the Baltimore & Ohio Railroad running between Baltimore and the North were compelled to take a devious course, and were transferred to a ferry running between Locust Point and Canton. The delay which this water transfer entailed acted for many years to the great disadvantage of the company, as other lines had a clear all-rail route through the city.

FIG. 1.—INTERIOR VIEW OF THE BALTIMORE BELT LINE TUNNEL, SHOWING LIGHTING ARRANGEMENT.

To do away with this delay, the Baltimore & Ohio Railroad secured legislative permission to construct a tunnel under the city, and in September, 1890, work was begun upon the tunnel and line, which now runs from Camden Station, in the heart of the city, north, and then east to Bay View Junction, a distance of 7.2 miles.

To construct this road the Belt Line Company was formed, and the actual construction of the tunnel and line was carried out by the Maryland Construction Company, a company formed for that purpose. The tunnel is one of the longest soft earth tunnels ever driven, and runs through the center of the city, immediately under Howard street, one of Baltimore's principal thoroughfares. It was built with almost no interruption to the incessant car and wagon traffic upon the surface of the street, and to secure this result several shafts to the tunnel below were sunk through the cellars of houses. The length of the tunnel is 7,339 feet, and the maximum dimensions, after lining, are 27 feet wide by 22 feet high. Its cost, ready for the track, is set down at $225 a lineal foot.

With the project for the construction of the tunnel the question of its ventilation became urgent. The General Electric Company offered to undertake the construction of electric locomotives of capacity sufficient to haul the heaviest trains, effect the entire equipment of the system, both for lighting and power, and thus to solve the ventilation problem.

Briefly, the electrical equipment and the work as first outlined was as follows: The locomotives were to operate from Henrietta street about 1,800 feet in the open to the portal of the tunnel at Camden street, and thence to the further end at Mt. Royal avenue, and for 4,600 feet further on in the open, or a total distance of about 14,500 feet. The locomotives were to join the rear end of passenger trains going north, at Henrietta street, and push both cars and locomotives through to the second station, from which point the steam locomotive was to do all the hauling. Freight trains were to be pushed the entire distance. The calculations were to be based on a maximum weight of 500 tons for each passenger train, including the steam locomotives, with a speed of 35 miles an hour, and on a maximum weight of freight trains of 1,200 tons at a speed of about 15 miles an hour, on a grade of 0.8 per cent. The number of trains each way was to be about 100 a day. An electric lighting plant with large incandescent lamps for the tunnel, and arc lights for the stations, was also contemplated.

The plan as outlined has been carried out with such modifications as have been found necessary as the work progressed. Preparations were made to commence the work of construction on the locomotives, so that they should be ready at the time the tunnel was opened, which event was set for March, 1893. The tunnel was, however, not finished until early this year, and the electrical installation was not begun until January, 1895. Nevertheless the delay had its compensating advantages. Electric railway apparatus had, during that time, been greatly perfected, and the plant now in the power house is of the most modern character, while the electric locomotives are the largest ever constructed.

The power house stands upon the west side of Howard street, east of the tracks leading to the southern portal, and between Henrietta and Montgomery streets, two blocks south of the Camden station of the Baltimore & Ohio Railway. It is a one-story building rising 30 feet from floor to eaves, with walls of brick one foot five inches thick. The roof of slate is supported on iron trusses, and the building is practically fireproof. It is divided into two parts, the engine room occupying the north portion, being separated from the boiler room by a brick wall. The entire length of the building is 322 feet one inch long; the dimensions of the engine room 223 feet 10 inches in length by 57 feet nine inches wide, and of the boiler house 98 feet three inches by 69 feet wide.

The boiler house is a spacious and lofty room, having 12 boilers (250 horse-power) arranged in six batteries, three of which are placed on each side of the center passage. It is lighted from the roof. The boilers are of the Root water tube type, from the shops of the Abendroth & Root Manufacturing Company. Each boiler is 12 tubes wide and 11 tubes high with six 14½-inch drums and a 30-inch steam drum. Space is left for an additional boiler on the west side of the room.

A system of mechanical draft is employed and the flues run over the rear of the boilers and taper from two feet nine inches square at the end to five feet square at the junction with the fan chamber, nine feet in diameter, in which two fans revolve at 240 revolutions per minute. This chamber is at the base of the iron stack, which is seven feet in diameter and 51 feet high from the floor. Each fan is belt-driven by a 10-horse-power vertical engine, set up on the floor of the boiler room, and one is of sufficient capacity to secure the necessary draft. The boiler room is further equipped with a coal crusher and conveyor, which brings the coal to the boiler and carries away the ashes from the ash pits; with duplex feedwater pumps and a 3,000 horse-power Webster feedwater heater.

The steam system is duplicate throughout, and was laid out in the engineering department of the General Electric Company. The pipe used is of wrought-iron with cast-iron flange and fittings and ground joints. Sudden demands for steam likely to be made at times necessitated special provision to take care of any water that might be siphoned over from the boilers into the system. The

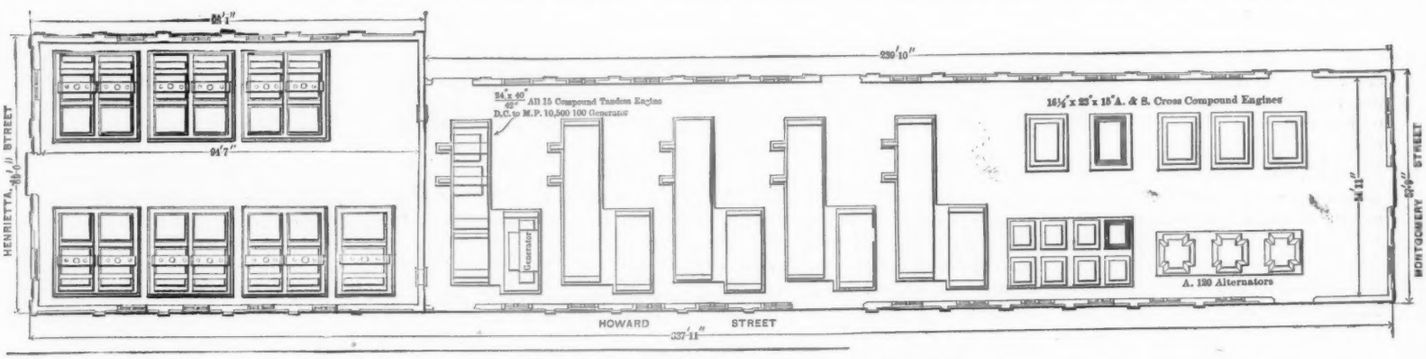


FIG. 2.—PLAN VIEW OF THE BALTIMORE BELT LINE TUNNEL POWER STATION.

mains from the boilers are, therefore, placed high enough to allow the water to drop into the separators, whence a "Lux" drip system returns all water from this point back into the boilers by gravity, and prevents its passage into the engine room system. Each main is provided with a 48-inch separator. A novel addition to each boiler, and one which should be used in all plants having more than one boiler, is the angle check and stop valve. The object of this valve is to shut off automatically from the system any boiler in which a tube has given way, or any part of which has met with accident. The advantage of such a valve will be obvious to all steam engineers who have seen their steam run down before the old style stop valve could be closed.

FIG. 3.—INTERIOR VIEW OF BALTIMORE BELT LINE TUNNEL POWER STATION.

The engine room is divided into two sections, one devoted to the power plant, the other occupied by the lighting generators. In the power section space has been provided for five direct-connected engines and generators, and four are now in place. The engines are horizontal, tandem compound Reynolds-Corliss machines, and have 24 and 40 x 42-inch cylinders. These engines were made by the widely-known E. P. Allis company, of Milwaukee.

The engines are built extra strong, on account of the severe work by which they will be taxed, and present the latest development of Reynolds-Corliss type. Directly coupled to them are 500-kilowatt General Electric multipolar generators, adapted to run with the engine at 110 revolutions per minute. The armatures of these generators are "overhung" on the outer end of the shaft. The arrangement, in this respect, differs from the regular practice of railway generators. The armatures differ from standard practice in being wound for 700 volts potential and are of the ironclad type, *i. e.*, the windings are embedded in slots cut into the outer periphery of the laminated armature body. The armatures are of the latest barrel wound type and present a very massive appearance. The fields are of steel, according to the well-known General Electric design, and run remarkably cool. The machine compounds from 600 volts no load to 700 volts full load. The performance of both the generator and engine under the severe fluctuations to which this character of work is subject shows that the apparatus must have been carefully designed, with reference to the peculiar conditions to which it was to be subjected.

From the railway generators the current is brought over cables of 1,000,000 circular mils cross-section to a switchboard of white marble, erected on a platform raised at the south end of the engine room. This switchboard consists of four standard "K" generator panels, each equipped with all the necessary instruments for controlling and measuring the current from one generator. The machines are protected from accident arising from short circuit by automatic circuit breakers, one of which is fixed to the upper part of each panel.

The northern section of the engine room contains the lighting plant, consisting of eight 50-light Thomson-Houston arc generators, and two alternators for the incandescent lamp service in the tunnel. The arc light machines are belted to two cross-compound Armington & Sims 250 horse-power engines, 16½ x 23 x 19 inches. Two other engines, of similar make and capacity, drive the two alternators, and space has been left for an additional engine and alternator. Each alternating generator has a capacity of 2,000 sixteen-candle-power lamps, and as the tunnel is lighted by 1,000 thirty-two-candle-power lamps, one alternator will suffice for the present illumination of the tunnel. Facing the lighting plant on the east side of the room is the lighting switchboard, also of polished white marble. It consists of one standard, 20 circuit, arc lamp plug board to which only 16 circuits are at present connected; three alternating generator panels, one of which is left blank, and one feeder panel. The arc lamps used in the illumination of the power house are of the Thomson 1893 type. In addition, it is lighted by clusters of three incandescent lamps each, fixed to the walls. The approaches and stations are lighted by Thomson-Houston standard arc lamps.

From the positive bus on the railway switchboard, eight cables of stranded copper, each of 500,000 circular mils cross-section, or a total cross-section of 4,000,000 circular mils pass to the overhead structure immediately outside the power house, where connection is made to three feeder cables of 1,000,000 circular mils cross-section each, and to the overhead conductor itself, which has an equivalent of 1,000,000 circular mils cross-section. The negative bus is similarly connected to the rails, which are double bonded with No. 0000 wire, and also to the return cables laid in a wooden box between the tracks. Perfect contact between bonds and web is obtained by using a hollow rivet on each end of each bond and expanding it, when inserted in the rail, by means of a conical steel pin.

The distance over which the electric locomotives will operate is about 15,000 feet, passing through two tunnels, 7,339 feet and 265 feet long, respectively, and over 7,396 feet of track in the open from Hamburg street to Huntington avenue.

Three tracks are laid into the southern portal, two tracks passing through the tunnel, four tracks from the northern portal, through the Mt. Royal avenue arch, and two tracks as far as Huntington avenue, where a siding is provided for the electric locomotives. There is a steady grade of .8 per cent from the southern through to the northern portal, and the lines in the open have two equated curves of 10 degrees, with a steady gradient of 1½ per cent. At the power house end of the line the locomotives run on a siding at the beginning of the long open cut running down to the southern portal.

The operation of the freight trains will begin at the main tracks south of the Camden station, where they will be switched into the cut. The electric locomotive will then couple on behind, without stopping the train, and push it through as far as the Mt. Royal avenue portal, a distance of 8,146 feet, the steam locomotive doing no work. After passing out of the tunnel, both steam and electric locomotives pull and push together up the heavier grade as far as Huntington avenue, the average speed over the entire distance being about 15 miles an hour. At Huntington avenue the electric locomotive will uncouple and run into its siding.

The plan of pushing the passenger trains through the tunnels has been abandoned, in view of the possible results if one of the cars or the steam locomotive should leave the track in front of the heavy electric locomotive traveling at 30 miles an hour. The passenger trains will, therefore, be pulled through from the Lombard street station near the south end of the tunnel to the Bolten street station at the north end.

The most interesting portion of the installation is, of course, the locomotives. Electric locomotives of such weight and power had never before been conceived, but it has always been a rule in American electric railway practice from the beginning to push ahead where improvements were possible and make the results realize the expectations, and there has been no departure from the rule in this case. The 96-ton electric locomotive is a success.

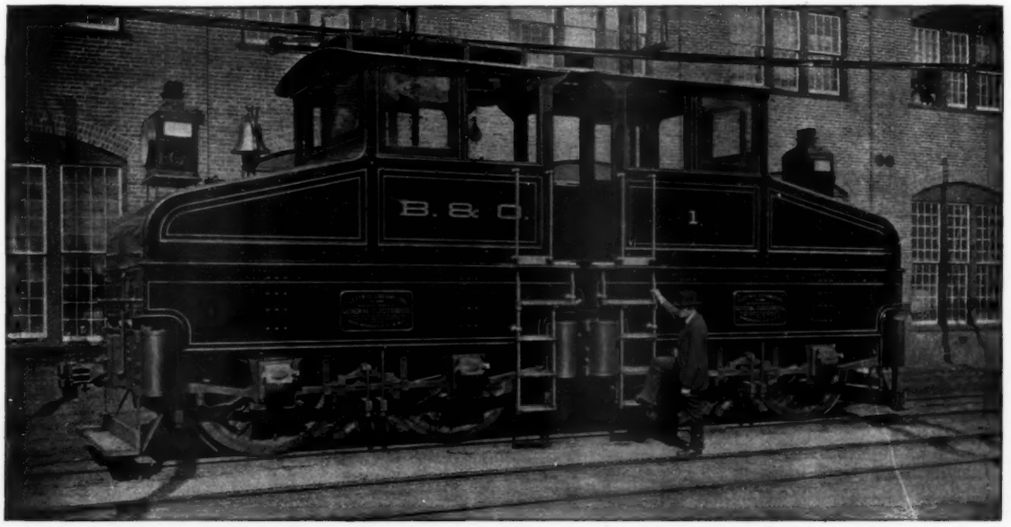


FIG. 4.—ONE OF THE NINETY-SIX-TON ELECTRIC LOCOMOTIVES USED IN THE BALTIMORE BELT LINE TUNNEL.

COMPOUNDING DYNAMOS FOR ARMATURE REACTION.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NIAGARA FALLS, N. Y., JUNE 26, 1895, BY PROF. ELIHU THOMSON.

Considerable attention has recently been drawn to the subject of means for counter-balancing or preventing armature reaction in dynamo generators or motors. The valuable paper of Messrs. H. J. Ryan and Milton F. Thompson, read before the Institute at its meeting on March 20,* called forth considerable discussion as to the actual utility or need of added devices, which undoubtedly

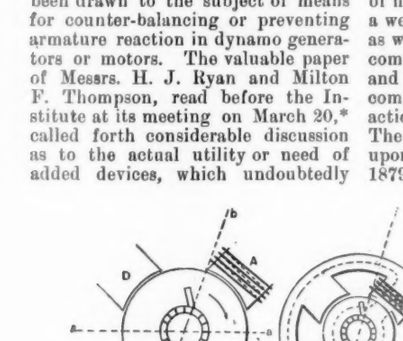


FIG. 1.

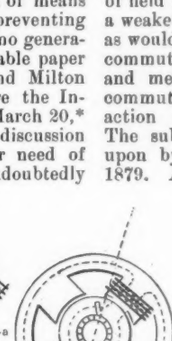


FIG. 2.

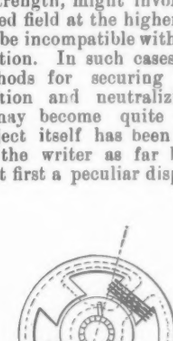


FIG. 3.

render a machine more complex, but which can certainly be made to obliterate armature reaction or overcome its effects. The opinion which seems to prevail amongst engineers is that by taking advantage of the best principles of design, the output of our machines is not limited by armature reaction, but rather by heating, or the capacity of diffuse that heat which is sure to be produced during operation.

The writer's views are in accord with the general sentiment indicated by the discussion of the paper in question, excepting that he conceives that it may on occasion become desirable to possess a structure, either a generator or motor, in which a load which would inevitably overheat the machine if continuous, may be borne without destructive results for short periods only. The development of engineering work may in fact demand, occasionally, machines which would be regarded as emergency machines, to be operated with the highest possible loads for short periods. It is sometimes desirable that a dynamo be adapted to driving at different speeds while maintaining the same potential at the terminals, as in the case of direct driven dynamos coupled with engines of different makes and speeds. Such an adaptation would require a change in the armature turns, or in the field excitation, the former demanding a reconstruction amounting to the production of a special type, while the latter, change of field strength, might involve such a weakened field at the higher speeds as would be incompatible with proper commutation. In such cases means and methods for securing proper commutation and neutralizing reaction may become quite useful. The subject itself has been worked upon by the writer as far back as 1879. At first a peculiar disposition of the field coils and pole pieces was selected, unfavorable to armature reactions, and later in a patent applied for by the writer in the year 1885, the series coil of a compound-wound machine was so disposed as to add, under load, a magneto-motive force to the field in the region of armature opposition, and as a consequence to diminish somewhat the magneto-motive force of the field where the reaction of the armature was positive, or assisting.

In the present paper, however, the writer desires to bring to the attention of the Institute a different type of dynamo, worked upon by him some three or more years ago, in which there is no series winding whatever, though the machine is in effect compounded, or over-compounded at will.

FIG. 4.

It is expressly to be understood at the outset that the present paper is not intended to advocate the disposition described as a desirable commercial structure, or even as one which will be likely to come into practical use on any scale. On the contrary, it is believed to be open to objections which would take it out of competition with ordinary types in which the compounding effect is secured by the series coil or load circuit wound as usual as a part of the field energizing conductor.

The machine is, however, interesting as bringing out forcibly the capability of the armature current to neutralize its own effects in a proper structure and maintain, or even increase, the potential at the brushes under heavy loads. In fact, the current in the armature in the type of machine herein treated, is made to react under load to magnetize a portion of the field structure which at no load is neutral or nearly so. The reaction may thus be made to give rise to a magnetic flux sufficient or more than sufficient to compensate for its effect in diminishing the flux of the other or excited portion. The result is accomplished by dividing each field pole into a portion which is left unwound and a portion which is wound and excited in shunt or separately. At no load only, the wound polar portions act to generate the open circuit electro-motive force. As the load is put on, the unwound or dead poles become active in consequence of a magnetic flux developed in them by the armature currents themselves, that is, in consequence of the magneto-motive force generated by the current in the winding of the armature itself. The disposition of the poles in the bi-polar structure would be represented by Fig. 1, where A A are the excited poles, or wound field cores, under the fringe of which commutation is effected, while D D are the "dead" poles or sections of polar surface unenergized at no load. A dotted line *a a* may pass through the neutral or non-polar portion of the armature iron, threaded by all field lines on one side, while the lines *b b* may indicate the diameter of commutation on which the brushes rest. In such a structure by choosing the position and spread of the "dead" poles in relation to that of the wound or excited polar portions, and adjusting the magneto-motive force of the initial field relatively to the turns on the armature and the speed of driving, the effect of compounding or over-compounding may easily be obtained. The "dead poles" may be made adjustable in position so as to vary the effective magneto-motive force of the armature upon them and various changes in relations of the parts are conceivable.

In Figs. 2 and 3, an attempt has been made to represent the magnetic flux under no load and under load, respectively. In Fig. 2 the flux in the air gap between the excited poles A A and the armature may be considered as of uniform density, except at the edges, while in Fig. 3 it is, under the same poles, somewhat diminished towards the diameter of commutation. In Fig. 2 the dead poles are without flux across the air gap, while in Fig. 3 the density increases from one edge to the other in the direction of rotation.

Fig. 4 is from a photograph of the dynamo constructed in accordance with the principle under discussion. It is multipolar, having four wound poles and four dead poles alternating in position around the armature. The latter is of standard iron projection type being in fact identical in construction and dimensions with the armatures used about three years ago in regular four-pole dynamos of the marine type of the Thomson-Houston Electric Company.

The principal data of the armature construction are as follows:

Diameter over all	17	inches.
Length (laminations)	8	"
Radial depth of laminations	4	"
Number of projections	87	
Width of slots	.84	inch.
Depth of slots	.75	"

The armature is series drum-wound and has two conductors in each slot. The commutator has 87 segments. The new field system was constructed of two rings of cast open hearth steel having heavy lugs, four in number, projecting laterally from each ring on one side and forming the dead poles when assembled in the machine. Separate castings for carrying the field coils and constituting the active poles were made, wound and bolted between the two ring castings of the field. The arrangement will be understood at a glance from an inspection of Figs. 5 and 6. Fig. 5 is a section of the field in a plane passing through the dead poles and the axis of the armature, and Fig. 6 is a similar section through the active or wound poles. The wound cores have a section of three and a half inches and are of steel. The field was bored to 17¼ inches, thus giving a clearance of one-eight inch around the armature. The excited or wound poles covered each about five inches, the dead poles each five and a half inches, leaving spaces between wound and dead poles of about one and one-half inches. The face of each dead pole is five and a half by eight inches.

The coils on the active poles can be connected in shunt to the armature terminals with a variable rheostat in the branch, or separately excited as desired. It was found that for the purpose of test that the latter arrangement was most satisfactory as the exciting current could then be adjusted to any given value and would remain undisturbed by variations in the potential difference between the brushes or terminals of the machine.

Fig. 7 shows the relation of volts at the terminals to varying exciting

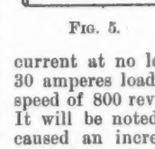


FIG. 5.

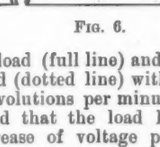


FIG. 6.

current at no load (full line) and at 30 amperes load (dotted line) with a speed of 800 revolutions per minute. It will be noted that the load has caused an increase of voltage particularly at the relatively higher excitations. The normal current of full load for the armature as constructed and used in the regular multipolar field was 140 amperes, and it was found that as the load was increased steadily during a run, the potential was not only maintained, but increased with each increment of load, thus showing an over-compounding effect. This effect was less marked when the initial excitation was weak; as when less than three amperes traversed the field coils. The over-compounding under load was, of course, still more increased when the field coils were connected in shunt to the armature. Thus, at a little over 750 revolutions per minute with an exciting current of four amperes, the open circuit volts were 84, rising to 104 when a load of 130 amperes was put on with an increase of the exciting current to 4.8 amperes.

It was noticed that on any considerable increase of load being made the potential rose, in some cases, as much as five or six volts above the point at which it would remain, or which it would reach after a short interval. Similarly, it was found that the sudden taking off of load caused a temporary fall below the stable voltage under the new or diminished load conditions. This curious effect was traced to the difference of time between that needed to build up or cut down the flux in the dead poles, as compared with that

*"A Method For Preventing Armature Reaction," by Harris J. Ryan and Milton E. Thompson. ELECTRICAL REVIEW, March 27, April 3, April 10, April 24, May 1, May 15 and May 22, 1895.

required to cut down or build up the excited poles which, being wound with wire, were naturally more sluggish under the conditions of use. Currents would be induced in the coils under each change of flux, which change itself would thereby be rendered more gradual. The dead poles being unwound could respond more rapidly. Any increase of load would, of course, tend to break down the wound poles and to increase the flux in the dead or unwound poles and the taking off of load would have the opposite effect.

Fig. 8 shows a compounding curve obtained under a constant excitation of four amperes at a speed of 790 revolutions, the load being varied from 0 up to more than thrice the full load. It will be noticed that the potential at first increases and only breaks down under extremes of load. The final breaking down is doubtless due to saturation of the forward portions of the dead poles, together with the armature core projections. Part of the drop was, undoubtedly, due to resistance at the brushes, which were of carbon, and by no means fitted to conduct off such heavy currents. Taking this drop and the drop over the armature conductor itself, it is not surprising that at the high loads the potential should fall off.

A horizontal plotting of the potentials, generated in the armature coils under no load obtained by the two brush method of Dr. S. P. Thompson, is given in Fig. 9, the relative positions of the wound and "dead poles" being marked in dotted lines and the arrow indicating the direction of movement of the armature relatively thereto.

Fig. 10 gives the same plotting under a load of 100 amperes and accentuates the effect of the armature reaction in magnetizing the dead poles. The curves are only approximate indications owing to the fact that the number of points at which readings were taken was less than was desirable, and because in some cases it was difficult to maintain all conditions unchanged, particularly with the very heavy loads.

Figs. 11 and 12 show a similar plotting for abnormal or extreme loads. The former shows how completely the wound pole has been broken down by armature reaction, and how the unwound poles have now become the chief working field poles, or, rather, how the armature winding itself has furnished the field for its own cutting. A calculation of the flux density at the forward edge of the unwound pole shows that the magnetization has risen to saturation. The other parts of the pole are shown to be still susceptible of increase of flux, but their relation to the armature is far less favorable for its generation.

The machine described is probably chiefly interesting from a theoretical aspect. Still it shows clearly that so far as the effect of the series field on compound wound machines is concerned, the electrical engineer has other resources at his command giving similar results. It cannot be doubted also that the design of armature and field might be considerably improved with special regard for the particular feature of compounding. A feature of the machine which developed itself when carbon brushes were used was that even at heavy loads the brushes could be set back from their maximum position, or true diameter of commutation in this case, and that the movement was attended with little, if any increase of spark, while the potential steadily went down. It was thus easily possible to adjust the potential by a backward movement of the brushes in the space between the unwound and wound poles, while the slight sparking under the carbon brushes was not increased thereby. The writer has never noticed this effect in so pronounced a degree in any other structures, but thinks that it may not be peculiar to this machine.

A further interesting consideration is the effect of dispensing with the wound poles altogether, and either neglecting to employ any reversing or commutating field while maintaining the brushes near the forward edge of the field poles which now remain, namely, the unwound poles, or employing commutating arrangements similar to those used by Mr. Sayers, that

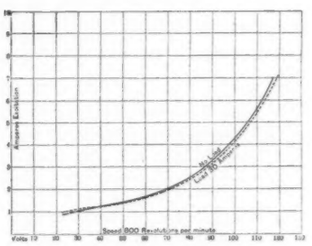


FIG. 7.

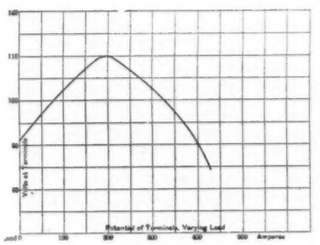
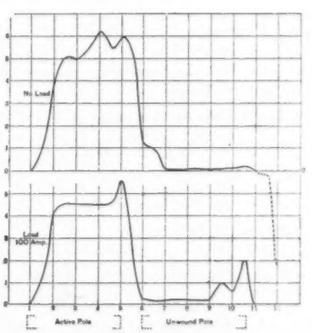


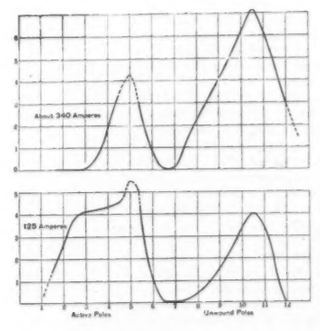
FIG. 8.

is returning the leads through slots in the armature under the strong induction of the forward edge of the pole as the armature leaves it. In such a case it would appear from theoretical considerations that the machine should, if it possessed any permanent magnetism, excite itself as a series dynamo entirely without any winding on the field and solely by the action of the armature winding itself. This fact was, I believe, first pointed out by Drs. J. and E. Hopkinson.

In conclusion it may be stated that tests of the machine used to generate single-phase and three-phase alternating currents in its armature winding were made by dispensing with the commutator and substituting rings and connections common in such cases. The results indicated a substantially similar effect of compounding, but to a less degree, owing no doubt to the fact that the phase of the electro-motive force generated by



FIGS. 9 AND 10.



FIGS. 11 AND 12.

the wound pole flux would not coincide with that due to reaction on the dead poles, since the position of the poles with relation to any portion of the moving wire is different at the same instant.

There was recently exhibited before the British Royal Society an electrical apparatus for indelibly marking linen. The linen is dampened and a current passed for two seconds from a silver die, carrying silver into the fabric wherever it touches. The current is then reversed for three seconds, reducing the metal. The result is that metallic silver is deposited on the tissue.

ELECTRIC RAILWAY NOTES.

It is rumored that negotiations are under way looking to the consolidation of the principal street railway lines in St. Louis by a London syndicate.

The earnings of the West End Street Railway Company, of Boston, for June will, it is believed, show an increase of above $60,000 compared with last year.

Lightning burned out the armature of the generator in the power station of the electric railway at Stamford, Conn., on June 28. The road had to shut down until repairs were made.

The Columbus Central Railway Company, of Columbus, Ohio, has recently purchased a private park of 155 acres, through which its lines are being extended. The park contains a lake nine acres in extent and will be developed into a high-class amusement resort. The only way of getting into the park is in the cars of the railway company. This company now has about 50 miles of high-class track in operation. The longest run is 14 miles. The road is one of the most conservatively bonded electric railways in the country.

At a recent meeting of the shareholders of the Washington & Great Falls Electric Railway Company, held at Washington, D. C., the offer of Stilson Hutchins to purchase the $100,000 six per cent gold bond issue —part of the $500,000 issue authorized—was accepted. At the same time the following directors were elected: J. P. Clark, S. T. G. Morsell, C. A. Maxwell, J. V. N. Huyck, Smith Pettit, F. H. Stier and W. E. Lewis. The directors then met and elected the following officers: J. P. Clark, president; S. T. G. Morsell, vice-president; Lee Hutchins, treasurer; and W. E. Lewis, secretary. The contract for the construction of the road will be let and work commenced at once.

TELEPHONE NEWS AND COMMENT.

A number of telephone exchanges are being installed in the South by Baldwin & Wilson, manufacturers of telephones, of Dawson, Ga.

The price at which the 10,000 shares of new Bell Telephone stock will be issued to stockholders has been fixed by the Commissioner of Corporations at 194.

In the ELECTRICAL REVIEW last week Mr. Paul Bossart was named as secretary and treasurer of the Telephone Protective Association. This was an error. Mr. P. C. Burns, of the American Electric Telephone Company, of Kokomo, Ind., has been elected treasurer—an admirable choice in every way.

A meeting of the stockholders of the New York, Orient & Montauk Telephone Company was held at Peconic, L. I., on June 27, with a representation of about 800 votes. The object of the meeting was to determine whether or not the stockholders were willing to sell their shares to the New York & New Jersey Telephone Company. The meeting was a lively one. It was decided by a large majority vote to sell the stock at par to the New York & New Jersey company.

In speaking of the new Telephone Protective Association to a Baltimore *News* reporter, Mr. J. R. Johnson, secretary of the Viaduct Manufacturing Company, of Baltimore, said: "The association will act in opposition to the Bell Telephone Company only in cases where that corporation seeks to maintain the existence of monopolies by means of patents which the members of the Telephone Protective Association hold have ceased to exist. The members of this association, equally with the Bell Telephone Company, are interested in maintaining all lawfully existing patents in the hands of the owners thereof. Exchanges will be established and maintained in all the large cities and towns, and pending the establishment of long-distance service, the association will endeavor to compel the Long-Distance Telephone Company, which is a creature of the Bell company, to handle the business as a common carrier.

Electricity from a Steam Railway Standpoint.

[*From the Railroad Gazette.*]

We have lately expressed the opinion that electric roads will occupy certain fields, namely, all city railroads, whether on the surface or above or below; also suburban service within some limited and indeterminate zone; also interurban service between cities and large towns not too far apart. Furthermore, it has seemed to us probable that electric railroads will do more of the local business between the small towns where it is permitted to lay such roads on the surface of the highways.

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SPECIAL NOTICE TO ADVERTISERS.

***CHANGES** for advertisements must be in this office by Friday noon for the following week's issue.*

***NEW ADVERTISEMENTS** should be in the office not later than Saturday noon to insure publication the following week.*

NEW YORK, JULY 10, 1895.

CONTENTS.

	PAGE
Views, News and Interviews	15
The New Era in Railroading	15
Repairing Commutators with Litharge Paste	15
Mr. J. J. Astor's Forty-Seven-Foot Electric Yacht	15
The Baltimore Belt Line Tunnel	16
Compounding Dynamos for Armature Reaction	18
Electric Railway Notes	19
Telephone News and Comment	19
Electricity from a Steam Railway Standpoint	19
Radiophony	20
Among Our Contemporaries	20
Niagara Falls Power	20
Wall Street and the Electrical Stock Market	21
Atlanta's Electrical Display	21
Eastern Telephone Manufacturers to Organize	21
Beacon Lamp Company	21
Lighting Bids Wanted	21
Annual Report of the Westinghouse Electric and Manufacturing Company	21
The Electric Fountain for the Cotton States and International Exposition	22
Northwestern Electrical Association	22
The Cause of Death in Electric Shock	22
Kind Words	23
An Incandescent Lamp with an Interior Mirror	23
The Whitney Electrical Instrument Company's Latest Products	23
A Welsbach Deal	23
Literary	23
Notes on the Reconstruction of a Small Central Station Plant	25
Boston News	27
Obituary	27
Advance Information	28
Electrical Patents	xi
Phonograph and Graphophone	xi
Kindred Interests	xii
Value of a Safety Fender for Electric Cars	xii

INDEX OF ADVERTISERS.

COVER PAGES.

	PAGE
Abendroth & Root Mfg. Co., boilers	xviii
American Electrical Works, insulated wire	i
Armington & Sims, engines	xviii
Boudreaux Dynamo Brush Co., a new foliated anti-friction metal brush	i
Bunnell & Co., J. H., dry batteries	i
Columbia Incandescent Lamp Co	i
Day's Kerite, insulated wire	i, x
Eastern Electric Cable Co., insulated wire	xviii
Fort Wayne Electric Corporation, Wood electric light apparatus	ii, vi
Goubert Manufacturing Co., heaters	xviii
Greeley, E. S., & Co., electrical supplies	xviii
Hammond Cleat and Insulator Co	i
Hampson, E. P. & Co., engines	xviii
Law Battery Co., open circuit batteries	i
National India Rubber Co., wire and cables	i
Okonite Co., insulated wire	i, xviii
Partridge Carbon Company, motor and generator brushes	i
Phenix Glass Co., globes and shades	i
Rhode Island Tool Co	xviii
Safety Insulated Wire and Cable Co	i
Standard Underground Cable Co	i
Stirling Co., water tube boilers	xviii
U. S. Telephone Construction Co., "M. & B." telephones	i
Weston Engine Co., engines	i

INSIDE PAGES.

Allen, L. B., soldering sticks	xii
American Bell Telephone Co	xv
American Electric Telephone Co., long-distant telephones	xiv
Automatic Electrical Specialty Co., miniature lamps	vi
Bain, Forée, electrical engineer	viii
Baillard, E. V	xiii
Baker & Co., platinum	xiv
Baxter, H. E., & Co., electrical supplies	x
Belden Machine Co., drop forging	xii
Benjamin, Geo. H., patents and patent law	viii
Bickford & Francis Belting Co., leather	xvi
Boynton Multivolt Battery Co	x
Bradbury-Stone Electric Storage Co., storage batteries	xi
Brill, J. G., Co., railway cars	xiii
Brixey, W. R., Day's kerite wires and cables	x
Brush Electric Co., arc lamps	vi
Central Electric Co., okonite wire, etc	iii
Chisholm, A., & Co., commutator compound	xi
Colgate Company, Geo. L., lightning arrester	xii
Connecticut Pipe Mfg. Co	vi
Crefeld Electrical Works, magnet wires	26
Crocker-Wheeler Electric Co	27
Cutter Electrical and Mfg. Co	xvi
Darlington, F. W., consulting engineer	xvi
Denny, J. T., & Co., octagon pine poles	xiii
De Veau & Co., telephones	xiv
Diehl & Co., fans of every style	iii
Dieterichs-Warwick Co., fan motors	xii
Dixon, Jos., Crucible Co., belt dressing	ix
Duval, Edward S., Jr., patents	xi
Dynamo-Electric Maintenance Co	xiii
Eddy Electric Mfg. Co., Eddy generators	xiii
Edson, Jarvis B., steam pressure gauges	v
Electric Launch Co	xvi
Empire China Works, porcelain specialties	xiv
Euler, H. C., mother-of-pearl	viii
Faraday Carbon Co., carbons	ix
Fienning, W. H., woven wire dynamo brushes	28
Forest City Electric Works, commutator bars	ix
General Electric Co., monocyclic system	ix
Globe Electric Construction Co., general contractors	xvi
Globe Electric Light Co., incandescent lamps	vi
Globe Metal Works, refiners of platinum	iii
Hill, W. S., Electric Co., switches	xiv
Hooven, Owens & Rentschler Co., electric railway and electric light engines	iii
Huebel & Manger, table push	viii
Interior Conduit and Insulation Co., Lundell dynamos and motors	xvi
International Correspondence Schools	viii
Keasbey & Mattison Co., magnesia sectional coverings	x
Lane & Bodley, street railway engines	iv
Leffel, Jas., & Co., waterwheels	xiv
Lehigh Valley Creosoting Co., creosoted lumber	xiii
Marshall, Wm., condensers	xii
McIntire, The C., Co., connectors and terminals	xii
Metropolitan Chandelier and Electric Supply Works	xiii
Metropolitan Electric Co	xiv
Metropolitan Telephone and Telegraph Co	xv
Moore, Alfred F., insulated electric wire	xv
Morris, Tasker & Co., tubes, poles, etc	v
National Telephone Mfg. Co., Desk sets	xv
New England Engineering Co	xiii
New Haven Car Register Co	iv
New York Belting and Packing Co., rubber belts	v
New York Insulated Wire Co	vi
New York & New England R. R	viii
N. Y. & Ohio Co., Packard lamps	v
Ostrander & Co., W. R., supplies	xii
Partrick & Carter Co., electrical supplies for housework	xii
Penberthy Injector Co	xvi
Philadelphia Telephone Co, Blake transmitter	xiv
Phillips Insulated Wire Co., wire	27
Pope, Reed & Rogers, patents	xi
Proposal, Street Lighting	viii
Riker Electric Motor Co	xvi
Royce & Marean, electrical supplies	xii
Safety Car Heating and Lighting Co	iv
Scott Electric Lamp Co	viii
Self-Winding Clock Co., clocks	xvi
Shipp, Jordan & Co., carbons	x
S. K. C. Electric Co	ix
Smith, Jas., Woolen Machinery Co	xvi
Solar Carbon and Mfg. Co., carbon specialties	xvi
Southgate & Co., W. B., watchman time recorders	v
Standard Electric Co., arc lighting	xii
Standard Thermometer Co., arc lamps	viii
Stanley & Patterson, electrical supplies	iii
Stevens, H. L. C., photo-engraving	iv
Stucky & Heck Electric Manufacturing Co	xvi
Syracuse Storage Battery Co	xv
Thayer Electric Co., electrical engineers	xvi
Varley Duplex Magnet Co., magnets	xiv
Waterman, Chas. H., arc lamps	viii
Washington Carbon Co., Helios cored carbons	iii
Western Electric Co., supplies	x
Westinghouse Electric & Mfg. Co	vii
Western Telephone Construction Co., telephones	xv
Weston Electrical Instrument Co., measuring instruments	x
White-Crosby Co., contracting engineers	xii
Wilkinson, W. H., automatic wiping device	xii
Worthington, H. L., electric signs, etc	iv

RADIOPHONY.

Mr. Semmola, an Italian electrician, has recently taken up the formerly much mooted question whether the effects of radiophony are due to the actual expansion and contraction of the body, acted upon by intermittent light rays, or by molecular vibrations of the body, causing in turn corresponding expansions and contractions of the air in contact therewith. As the result of numerous experiments, Mr. Semmola announces that the intermittent light beam affects the actual expansion and contraction of a body; in other words produces mechanical vibrations of matter. To substantiate his assertion, he cites some experiments, performed with the new Antwerp granular carbon transmitter, whose essential or characteristic feature consists in a minute *separation* between the front diaphragm and the working electrode.

In this connection, we refer Mr. Semmola to Mr. Preece's opinion, as expressed in his address before the institution of Civil Engineers, April 18, 1881:

Mr. Graham Bell still maintains that the disk *does* vibrate and will *not* admit that the experiments, given in my paper before the Royal Society, are conclusive, but adheres to his own original idea that it is the action of light upon the disk, and will not admit that it is due to the expansion of air. But Mr. Mercadier curiously enough has shown that he got the sounds just the same, though the disks were cracked, and on my recent visit to Paris he was kind enough to give me a disk which is cracked in all directions, but nevertheless emits sounds as if it were intact. That must be sufficient to show that the sounds are *not* produced by the vibration of the disk, for we all know that cracked bells do not give the same sounds as when uncracked. If the sounds were due to the vibration of the disk, different substances would emit different sounds.

The transmitter referred to by Mr. Semmola as the "new Antwerp transmitter" is patented in Great Britain to a Mr. Goffin, of Brussels.

AMONG OUR CONTEMPORARIES.

The current issue of *Cassier's Magazine* is a beautiful number devoted entirely to the Niagara Falls enterprise. The ablest authorities on the subject, the engineers in charge of the great power installation, have contributed valuable articles which are illustrated from equally valuable photographs and drawings.

Two of our esteemed contemporaries merit especial notice at this time. The *Western Electrician*, with its issue for July 6, 1895, entered upon the ninth year of its existence. We congratulate our Chicago contemporary on the successful attainment of this very respectable age and we express the hope that its present prosperous condition may long continue. The *Street Railway Journal* for July is an unusually attractive and valuable issue. It contains an excellent editorial on the possibilities of electricity for steam railway service and what is believed to be the most complete table of street railway statistics of mileage, cars and capitalization which has yet appeared.

We note the advent of *The Electrical Journal*, edited by our friends Dr. F. A. C. Perrine and Geo. P. Low and published monthly in San Francisco. The newcomer candidly admits that "our newsy friend, the ELECTRICAL REVIEW, is entitled to the distinction of being the 'oldest weekly,'" and states as its motto that *The Electrical Journal* is to be known as "the newest electrical publication in America." We wish the new venture success. Judging from the excellence of its book reviews we opine that it will pay especial attention to this department. We suggest that the name of the city where our young contemporary is published be given a place on its front cover.

NIAGARA FALLS POWER.

Press dispatches from Niagara Falls, N. Y., dated July 1, stated that "the first electric power transmitted for commercial purposes from the plant of the Niagara Power Company, at Niagara Falls, found its way from the great power house through the electrical subway for a distance of about a mile yesterday morning and put in motion the machinery of the Pittsburgh Reduction Company. Four thousand horse-power of electricity was delivered, and engaged in the manufacture of aluminum."

The facts are that the machines were simply turned over and the amount of power transmitted was only enough to turn the machines, as the Pittsburgh Reduction Company is not yet in actual operation.

It is expected that the No. 2 generator will be supplying 5,000 horse-power within 30 days, and that additional dynamos will be put in operation with great rapidity, now that the success of the work has been assured.

Although the inclement weather on the Fourth of July in nearly all parts of the country seriously interfered with the business of the electric railways, yet the ELECTRICAL REVIEW is informed that the traffic returns in most of the large cities and towns show very satisfactory results.

Wall Street and the Electrical Stock Market.

The stock market this week ran to the Industrials. Early transactions were largely professional and were on the short side. This carried down prices throughout the list and in the last three days the same contracts were covered. On this buying values reacted to their former level. There was very little in the market aside from the professional interest. The capitalists at home and abroad are waiting for the development of the crops before taking any greater interest in securities than they now possess.

Electrical stocks were moderately quiet and active. General Electric showed considerable strength despite the efforts to depress it. There is a feeling that recent developments in the use of electricity on roads formerly operated by steam foreshadow a revolution in favor of the first-mentioned motive power. The Nantasket experiments, fully set forth in the ELECTRICAL REVIEW of last week, were read with much interest by brokers and contributed to the bullish feeling towards the two great manufacturing companies now in the field.

The Westinghouse report, which is published in full in another place in this issue of the ELECTRICAL REVIEW, is not a fair index to the electrical business of the year which it covers. Owing to the disturbance which was caused by the removal of the company's plant the returns were a little more than enough to pay the dividend on the preferred and the fixed charges. The expenses of the new plant at East Pittsburgh were temporarily met with loans. These are to be funded into a collateral trust bond. To this end, as well as to provide for moneys to be expended in extending the Brush lighting companies of New York and Baltimore, $1,250,000 collateral trust 5 per cent bonds are to be issued. The report lays great stress on the control of the Tesla multiphase motor patents, without which, it claims, it is impossible to operate economically roads now run by steam. President Westinghouse does not regard the delay in the McKeesport case as at all unfavorable.

General Superintendent Bradley, of the Postal Telegraph Company, informed me this morning that his company has been offered $15,000,000 for the control, by the Standard Telephone Company, which is believed to be backed by American Sugar and Standard Oil capital. The offer was refused on the ground that the owners did not care to sell at that price. I understand that the Postal is leasing wires between New York and Chicago for $16,000. The rate formerly charged by Western Union was $25,000. This was cut to $18,000 by the Bell company who also gave telephone service in connection. The relations between the Postal and the Metropolitan Telephone Company, of New York city, are said to be very friendly despite the Western Union interest in the latter. All well-posted electrical manufacturers are just now interested in the copper situation. The business in Lake copper is light, although prices are firm at 10¾ cents. Electrolytic is quoted at 10½ cents. Movement in copper stocks foreshadows higher prices for copper. Since January 1 there has been very heavy appreciation in the value of copper properties, notably those which found it difficult to operate at a profit with copper below 10 cents. Boston and Montana gained over 100 per cent and are now selling at about 71 or the highest price ever recorded.

New York & New Jersey Telephone Company has declared a quarterly dividend of 1½ per cent, payable July 15. The Southern Electric Railroad, of St. Louis, has declared a dividend on its preferred stock of 3 per cent, payable July 1.

On the Boston Exchange, Bell Telephone on Tuesday sold at 194½ ex-4½ per cent dividends. Erie Telephone was unchanged at 57 @ 57½. New England Telephone advanced towards the close of the week 2 per cent to 77 bid and 78 asked. Electric Storage Battery was rather quiet, and in later dealings lost 1 per cent to 2 per cent.

Under the Massachusetts law the Commissioner of Corporations has fixed 194 as the price at which the 10,000 shares of new Bell Telephone stock shall be offered to stockholders. This has put the market at that figure for the present.

A comparison of bid and asked prices of various electrical stocks, most of which are inactive, is appended. They show but little change, although there is some improvement in almost every stock. Bell telephone is an exception. A part of its decline is due to the payment of 4½ per cent in dividends.

	July 6.		June 6.	
ELECTRIC:	Bid.	Asked.	Bid.	Asked.
Boston Electric Light	109	....	....	....
Br.dgeport Elec. Light	32½	35	32½	35
Con. El. Lt., Portland	8¼	9	8¼	9
Diamond Elec. Light	5	5½	5	5½
Edison Ill., Boston	134	....	130	....
Edison Ill., Br oklyn	108½	109½	102	105½
Edison Ill., Chicago	125½	126	126½	129
Edison Ill, Philadelphia	....	119	117	119
Edison Ill., New York	99¾	101½	98	101
El. Lt. & P., S. Francisco	91¼	91¾	....	....
El. Lt. & P., Savannah	59½	61	....	....
Eddy El. Manufactur'g	20	30	....	25
Hartford Electric	....	....	101	107
Lowell Electric	91	91	91	94
Mo. (St. L.) El Lt. & P.	....	100	....	100
New Haven Elec. Light	147	....	147	....
Narragansett Electric	82	84	81¼	82
Powe.ton Electric	10	10¼	10	10¼
Rhode Island Electric	....	122	....	122
Salem Electric	101	110½	101	105
Southern Electric	8	8½	8	8½
Suburban Electric	9½	10	9½	10
United States Elec. Lt.	134	135½	137	....

	July 6.		June 6.	
TELEPHONE:	Bid.	Asked.	Bid.	Asked.
American Bell	194	195	202	203½
American Telephone	3	3½	3½	....
Bell Telephone of M	175	185	175	185
Central Union	51½	....	50	52
Chesapeake & Potomac	57½	60¼	59	60¼
Chicago Telephone	166	175	166	175
Cumberland Tel.	49	51	45	47
Erie	57	57½	57½	57½
Hudson River	40	44	38	42
Missouri & Kansas	40	50	....	....
New England	77	78	71¾	72
New York & New Jersey	100	....	105	107
Providence	88	....	94	94¾
Southern New England	92	94	....	....
Tropical	....	10¢	....	10¢
Troy Tel. & Telegraph	90	....	....	....

BAIN.

New York, July 6, 1895.

Those twin travelers, Messrs. M. C. Roach, general eastern passenger agent of the N. Y. C. & H. R. R. R. and C. O. Baker, Jr., the platinum magnate, returned to New York on the "Lucania" last Friday after a six weeks' trip in Europe. The railroad companies of Great Britain and the continent were especially courteous to the American travelers, and as neither holds a public office "within the meaning of the law," they could accept these courtesies without embarrassment. "It was their duty and they did." Their trip covered England, Ireland, Scotland, Holland, Belgium, Austria, Germany, Switzerland and France.

ATLANTA'S ELECTRICAL DISPLAY.

ELECTRICAL PROGRESS AT THE COTTON STATES AND INTERNATIONAL EXPOSITION.

The general indications are that everything will be ready for the prompt opening of the Cotton States and International Exposition at Atlanta, Ga., in September next. Especially rapid progress is being made with the electrical work. The lighting of the grounds has been designed mainly to show what can be done in the way of embellishment and in giving them a cheerful and festive appearance.

The Electricity Building is ready for the reception of exhibits and the work of installing them is now well under way. The exhibit of the American Bell Telephone Company will, it is said, be much handsomer and more complete than the one shown by this company at the World's Fair. It is the idea to have it finished and in complete order before the opening of the Exposition and the indications are that this idea will be carried out. The large spaces in the center of the Electricity Building have been secured by the General Electric Company and the Westinghouse Electric and Manufacturing Company. The former will exhibit, among other things, its monocyclic system, and the latter will include in its exhibit the Tesla two-phase system. Other leading electrical companies have applied for space, some of which has been assigned. The applications far exceed the space at disposal and some companies will not get as much as they want.

Eastern Telephone Manufacturers to Organize.

A number of the manufacturers of telephones and telephone apparatus in New York and New England have been considering the question of forming an association, with headquarters in New York city, to protect their interests. A favorable decision has been reached. It is expected that the organization will be effected this week, and will include New York, Boston and Philadelphia manufacturers as well as those in smaller cities included in this territory. Mr. H. T. Johnson, of the Manhattan Electrical Supply Company, and Mr. A. F. Stanley, of DeVeau & Company, New York, are interested in the movement. The name of "Eastern Telephone Manufacturers' Association" has been considered and may be adopted at the meeting this week.

Beacon Lamp Company.

The Beacon Vacuum Pump and Electrical Company has disposed of its assets to the Beacon Lamp Company, who will continue the business of manufacturing and dealing in vacuum pumps and incandescent lamps at the factory on Irvington street, Boston. In addition to acquiring all the equity in the old company, the Beacon Lamp Company announces that it will have a further asset of $40,000 in cash. The new company is incorporated under the Maine laws, with $500,000 capital stock and the following officers: President, Isaac Weil, of Boston; secretary, L. E. Whicher, of Boston.

Lighting Bids Wanted.

Madisonville, Ky., is ready to receive bids to furnish the city with 30 or more 2,000 candle-power arc lights. Specifications and particulars may be had from I Bailey, general manager of the Reinecke Coal Company, Madisonville, Ky.

ANNUAL REPORT OF THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY.

PRESENTED ON JULY 2.—THE REPORT IN FULL.

The annual report of the Westinghouse Electric and Manufacturing Company was sent out to the stockholders on July 2 by President George Westinghouse, Jr. The report appears below in full:

PITTSBURGH, PA., July 2, 1895.

To the Stockholders of the

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY:

Your Board presents herewith its report, with the financial statement for the year ending March 31, 1895.

The all-important feature of the year's business has been the creation of a magnificent workshop, having unequaled facilities for the carrying on of the business in which your company is engaged, and the concentration therein of the manufacturing operations formerly conducted under great difficulty in three widely separated works, with material stored in numerous warehouses.

These new works, located at East Pittsburgh, about 12 miles east of Pittsburgh, are extensive and exceptionally complete in every detail necessary to the production of the best class of apparatus at the lowest possible cost, and will thus insure to your company many advantages. These new works were erected during a period of exceptionally low prices for labor and material, and under other favorable circumstances, so that the cost shown in the accompanying balance sheet is greatly below earlier or present prices for like work.

As was to be expected, such extensive building operations and the removal of materials from the old to the new works reduced the output for the year to about three quarters of what it would have been without the interruption and extra work entailed.

The annual meeting of the stockholders of the company was adjourned at the regular date (May 15) to July 17, as the transfer from the old to the new works had not at the earlier day been fully effected, it having proved far more difficult and complicated than your directors had anticipated. They are glad to be able to announce that it is now completed, with results which promise to be most satisfactory in the immediate future of the company. It was the desire of the board that at the annual meeting every opportunity be afforded the stockholders to see for themselves what had been accomplished, and so form their own opinions of the efficiency of the plant and the value of the property. This was not possible in May; it is possible now. The directors, therefore, earnestly invite all holders of the company's stock who may be able and desire so to do to attend, in person, the annual meeting on July 17, at Pittsburgh, where special railway and other arrangements will be made. Meanwhile, the directors feel justified in saying that the works are as nearly perfect as they could now be made, and are now operating to the entire satisfaction of those in charge, and that the production has already been increased to a point where the demands of all customers can be promptly met, and there now seems to be no reason why your company should not in the near future be as large a producer of electrical machinery as there is in the country.

In anticipation of the increased facilities which your company would have in its new shops, a large amount of time and energy were put into the development of new and better forms of apparatus for the trade, and this extra work, together with that incident to the preparations necessary to occupy the new quarters, increased the general and extra expenses to a figure somewhat above that for the year ending March 31, 1894.

So far as ascertained there was expended directly in removing the machinery and material $90,499.54, after deducting which from the earnings from business and from other sources, there is left a net profit of $711,909.68.

This, also, it must be borne in mind, was the outcome of a business year during which, for reasons already stated, your company was working under conditions as to output, which, in the opinion of your directors, were so unfavorable that the net results scarcely represent half of what might reasonably have been expected under ordinary circumstances.

(Concluded on page 24.)

The Electric Fountain for the Cotton States and International Exposition.

The plans of Mr. Luther Stieringer, consulting electrical engineer of the Cotton States and International Exposition, for an electric luminous fountain were accepted by the exposition authorities on June 29, and contracts have been closed for a considerable portion of the construction work. Mr. Stieringer has provided for a twin luminous electrical fountain of original design on a larger scale than anything heretofore projected. Many new features will be introduced, and the best features of previous fountains will also be provided.

The water display will consist of wheat sheaves, ring curtains, rings of geysers, oscillators, lily jets, large and small parabolas, and also a mist bank and a mammoth geyser. The mist bank is an entirely new feature in hydraulic effects, enveloping the fountain area in a dense mist of spray, which, when illuminated, will furnish a most striking display of variegated colors. To attain the countless hydraulic effects of which the fountain is capable, an immense network of pipes is required to distribute the water necessary to supply the 2,100 orifices which may be called into play in producing the various combinations mentioned. This water is furnished to the fountain at 100 pounds pressure through a 16-inch main having a capacity of 15,000 gallons a minute. Twenty-three high candle-power electric lights will be utilized.

The site finally selected for the fountain is in the center of the grand basin, opposite Machinery Hall. Rising from the surface of the lake, the fountain structure containing the operating chamber will present the appearance of a half submerged rocky island of irregular form, having a length of 100 feet and extreme width of 50 feet. In addition to its evening displays, the fountain is designed to be operated during the daytime with a reduced volume of water.

Northwestern Electrical Association.

The Summer meeting of the Northwestern Electrical Association will be held at the Leland Hotel, Michigan avenue and Jackson street, Chicago, on July 17, 18 and 19. Mr. S. F. B. Morse, 1014 Marquette Building, Chicago, can supply information as to rates. The following is the general programme of the meeting:

Wednesday, July 17—9 to 12 A.M., business meeting; 2 P. M., inspection of the Chicago Edison Company's Harrison street station and the Metropolitan elevated electric railway.

Thursday, July 18—9 to 12 A. M., business meeting; 2 P. M., trip on special train along the Chicago drainage canal as far as Joliet, Ill.; 8 P.M., theater party at Columbia Theater, "The Merry World."

Friday, July 19—9 to 12 A. M., business meeting; 2 P. M., drives in the South Side parks and boulevards and a visit to the World's Fair grounds.

THE CAUSE OF DEATH IN ELECTRIC SHOCK.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NIAGARA FALLS, N. Y., JUNE 27, 1895. BY A. M. BLEILE, M. D., PROFESSOR PHYSIOLOGY, OHIO STATE UNIVERSITY.

The work here given was undertaken with a view to elucidating the effects of larger quantities of electricity on the organism. Incidentally the value of artificial respiration after death by electricity was also tested. As this is the minor portion of the work this part will be given first.

The data bearing on the subject in general are quite meagre, especially as to the amount of current which actually passed through in fatal cases.

No.	Weight (lbs.).	Volts.	Amperes.	Time (seconds).	
1	21	525	2	8	Artificial respiration 40 min.—Death.
2	15	220	1.2	8	Artificial respiration 25 min.—Death.
3	30	106	.4	10	Artificial respiration 1 hr. 15 min.—Death.
4	42	98	.4	4	Artificial respiration 2 hrs. 30 min.—Death.
5	27	96	.3	2	Artificial respiration 1 hour.—Death.
6	21½	52	.3	1 Recovery. 2 Recovery. 4 Death.	
7	17	70	.32	.5 Recovery. 1 Recovery. 1. Recovery. 2 Recovery.	
8	40	47.5	.25	4	Death.
9	35	96	.35	1	Death.
10	30	52	.25	2 Recovery. 4 Death.	1-30 grain atropine
11	28	52	.29	2 Recovery. 4 Death.	3-60 grain atropine
12	26	50 97	.24 .54	4 Recovery. 1 Death.	1-25 grain nitroglycerine
13	30	48	.22	4	1-20 grain nitroglycerine.—Death.
14	33	52 104	.22 .6	4 Recovery. 4 Death.	1-50 grain nitroglycerine
15	22	51	.32	4	6-50 grain nitroglycerine.—Death.
16	22	47	.2	4	1-10 grain nitroglycerine.—Death.
17	27	52 106	.2 .55	4 Recovery 1 Death.	1-10 grain nitroglycerine
18	36	51	.25	4	80 grains chloral 1-50 grain atropine — Death.
19	30	52	.24	3	Death.
20	51	52	.24 .25 .30	3 Recovery. 4 Recovery. 6 Death. (22 deep respirations.)	
21	25	50.5	.2	3	Death.
22	19	51	.2	3	Small dose nitrite of amyl.—Death.
23	17	51	.2	3	Small dose nitrite.—Death.
24	34	50.5	.2	3 Recovery. 6 Recovery.	Full dose nitrite
25	38	50.5 101	.2 .2 .5	4 Recovery. 6 Recovery. 1 Death.	Full dose nitrite
26	34	51	.12 .18 .2	4 Recovery. 4 Recovery. 4 Death.	
27	12	50	.2	4 Recovery. 6 Death.	Full dose nitrite

DATA ON THE CAUSE OF DEATH IN ELECTRIC SHOCK.

In all my experiments dogs were used, and in the subjoined table the weight, voltage, amperage and time are given for each case.

In the first experiment 525 volts, 2 amperes were applied for 8 seconds; in the second, 220 volts 1.2 amperes; in the third, 106 volts .4 ampere, 10 seconds; in the fifth, 96 volts .35 ampere, 2 seconds; in the sixth, 52 volts .3 ampere for 1, 2 and 4 seconds; in the seventh, 70 volts .32 ampere, ½, 1 and 2 seconds, were used.

Before the application of the current a canuala was put into the trachea so arranged that it could at once be connected with a bellows for the purpose of giving very complete artificial respiration. Respiration was set up as soon as the current was off and this was continued for periods varying from 20 minutes in the first case to 2½ hours in the last, and in no instance was resuscitation accomplished.

Further work was carried on for the sole object of studying the effect of the current.

Our electrodes consisted of oval copper plates three by two inches, covered with sponges moistened with salt water. One electrode was applied at the base of the skull, and the other over the middle of the back, the hair of the animal having been previously well moistened with the salt solution. The current used was the alternating current of 130 periods per second. While the details of each experiment are given in the table subjoined, a few are selected for special presentation. The larger voltages were abandoned for 100 volts, 70 and 50, as near as could be reached.

Ninety-eight volts with .32 ampere were applied first ½ second, then 1 second with recovery, but in two seconds produced death. Fifty-two volts with .3 ampere were applied 1 second, later 2 seconds, with recovery, then 4 seconds, producing death. Fifty-two volts, .24 ampere applied 3 seconds produced death. Fifty-one volts, .12 ampere, 4 seconds; 51 volts, .18 ampere, 4 seconds were not fatal. Fifty-one volts, .2 ampere, 4 seconds produced death. From these figures and similar ones to be obtained from the table, it is evident that the result depends, somewhat independently of the weight of the animal, on three factors: On the voltage, on the amperage and upon the time of application. A variation of any one of these factors may change the result—that is, a lower voltage with lesser amperage applied for a longer time will have the same effect as a current of higher voltage or more amperage applied for a shorter time. In this connection it was suggested by Professor Thomas that the joules necessary would be found the same in each case, and calculations show that this is approximately true. To prove this absolutely it would, of course, be necessary to work with the minimum quantities as to voltage, amperage and time in each case, and no doubt one or another of these factors will be found in excess in most cases. In these experiments it is of great interest to point out this approximate relation between the results and the absolute amount of mechanical energy used. The results found on post mortem examination of the animals were so uniform that they can be very briefly described. In all cases this examination was made immediately after death, and at first we wished to study the changes produced upon the heart, so that the incision was made through the chest walls and the heart exposed as rapidly as possible. This organ presented the following peculiar conditions: The left side was completely relaxed, the right side was intensely gorged with blood, as were also the large veins in the immediate vicinity of the heart, and the little appendages of the upper portion of the heart were found beating regularly, strongly and synchronously. Pressure on the heart caused a contraction of the other parts, and from this it was evident that death was not due primarily to the destruction of the heart fibers. In addition it was noted that the deep and extensive cuts made in the tissues were free from blood, and that the arteries were quite small and contracted.

This excluded a direct effect upon the heart, and having shown by artificial respiration that the stoppage of this function was not the cause of death, other causes were to be looked for.

It was supposed that the current immediately struck the pneumogastric nerve, stimulating those fibers which control the heart, in that they have the power of arresting its beat when strongly stimulated. To test this view resort was had to the hypodermic injection of atropine, the action of which drug is to paralyze the nerve fibers, and thus prevent their action on the heart when stimulated. In one case $1\frac{1}{30}$ grain of atropine was given; 52 volts with .25 ampere were applied first for two seconds, then for four seconds, and this resulted in death. In a second case $\frac{1}{20}$ grain of atropine was given; 52 volts with .29 ampere were applied first two seconds, then four seconds, again resulting in death. These animals were not therefore rendered more resistant by the drug, and the theory as to the role of the pneumogastric nerve was abandoned.

I now recall the fact already mentioned that after death incisions into the animal are not followed by bleeding, that the arteries are contracted down to a very small caliber, and that the blood is crowded into the very large veins in the trunk. Taking these facts, it was suggested that the current acted upon the arteries through the nervous center which controls their diameter. It is well known that the arteries are supplied with a middle muscular coat in which the fibers are circular, and their contraction would, of course, cause a narrowing of the artery, rise of the blood pressure, and a consequent impediment of the heart's action; in fact, it has been experimentally demonstrated that the arteries can be constricted to such an extent as to produce a rise of blood pressure which the heart is unable to overcome, and that the circulation will stop from this cause. It is further known that we have in the brain most of the nerve matter whose function it is to control the vaso-motor nerves, the arteries at one time and in one place contracting, and thus decreasing the

amount of blood; at another time and in another place dilating, and thus increasing the amount of blood getting to another particular part. To test this view, that the action of the vascular nervous system was the cause of death, we resorted to the hypodermic use of nitroglycerine. It is known of this drug that it powerfully affects the arterial system, causing, when given in large doses, an extreme dilitation of the arteries, and a consequent great lowering of the blood pressure.

The first animal received $\frac{1}{15}$ of a grain of nitroglycerine, and when the effects were fully established, a current which was known to be fatal was thrown in—namely, 50 volts, .24 ampere for 4 seconds—but the effects produced by this current soon passed off, and there was complete recovery. Then 97 volts with .54 ampere were thrown in for 1 second, but this caused death. In another case $\frac{3}{15}$ of a grain of nitroglycerine was used. Here 25 volts .22 ampere, a fatal dose, were thrown in for 4 seconds with recovery. One hundred and four volts .6 ampere were thrown in for 4 seconds, producing death; but after the current was taken off there was noted 8 deep, although irregular, respirations. In other cases where the nitroglycerine was used there was no apparent effect, but some investigation led me to attribute this to the unreliability of the tablets of nitroglycerine used, and this drug was thus abandoned for nitrite of amyl, a substance which has the same physiological effects as nitroglycerine, but which can be always obtained pure, and the effects of which can be more accurately regulated because it is given by inhalation. In the first case the animal was brought moderately under the influence of the nitrite of amyl, 52 volts with .24 ampere were thrown in for 3 seconds (this, by the way, being a fatal dose ordinarily) without producing death. Fifty-two volts, .25 of an ampere for 4 seconds, also a fatal dose, failed to produce death. Fifty-two volts, .3 of an ampere for 6 seconds produced death, but after the current was taken off, the animal made 22 deep, regular respirations, though not a trace of the heart-beat could be made out, this incidently proving that stoppage of the respiration is not the primary cause of death.

Three more experiments may be selected; Numbers 24, 26 and 27 of the table.

No. 24 was a pointer dog in excellent condition, weighing 34 lbs. Nitrite of amyl was given until the effects were fully marked. Fifty and five-tenths volts with .2 ampere were given for 3 seconds; after a pause the same quantity was given for 6 seconds, followed by recovery. Three days later the same dog, who showed no effects at all of the previous treatment, was given—without the nitrite of amyl—51 volts, .2 ampere, 4 seconds, producing death.

In the last case a dog weighing only 12 pounds and of such general condition of weakness that the assistant protested against his use as not being competent to demonstrate anything, was given a full dose of nitrite, then 50 volts with .6 ampere were applied for 4 seconds and followed by recovery. The dose applied for 6 seconds produced death and here again several respirations were noted.

The statements made in regard to the cause of death by electricity are so at variance with one another that it is unnecessary to review them here. Among other plausible reasons it has been stated that the current has a direct disintegrating effect on the brain and nerve tissues, and that herein is to be found the cause of the fatality. The disintegrating effects of the current on the brain and nerve tissues said to follow are not to be seen microscopically, and the microscopic examination of these organs, so far as made by us, failed to reveal any change in their structure. It would appear, therefore, that death in electric shock is entirely due to the fact that the current produces a contraction of the arteries through an influence on the nervous system, and that this constriction of the arteries throws in such a mechanical impediment to the flow of the blood as the heart is unable to overcome, and that where drugs are given to counteract this effect much larger doses of electricity than the ordinary can be borne. While artificial respiration may be of value in simple stunning when larger doses have been taken, no rational means of resuscitation have as yet been suggested.

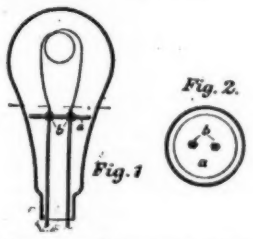
I was enabled to carry out the above experiments by the loan of apparatus kindly furnished by Professor Thomas and was greatly assisted in the work by Mr. Boyd, of the physical department, who was present at every experiment and who made the measurements for us.

The current was obtained from a surface-wound alternator giving an approximate sine-curve. For potentials of 100 volts or less, connection was made with the secondary of a suitable transformer. Potentials of over 100 volts were taken direct from the primary circuit, adjustment being made by varying the generator field.

Voltages were measured by means of a Weston alternating current voltmeter. The mains supplying the current were of low resistance, so that the drop when the circuit was closed was found to be negligible. The figures given are the actual potential differences of the electrodes while the current was flowing through the animal, correct to within one-half volt. A Siemens dynamometer was used for measuring the current when the time of contact was less than four seconds. It was somewhat difficult to make a setting, so that readings for those short times cannot be taken as correct within five per cent.

An Incandescent Lamp with an Interior Mirror.

A. Lucchesini, of Florence, Italy, is the inventor of an incandescent lamp in which a flat mirror is placed inside the glass globe and through which the filament runs. The chief advantage claimed is that the mirror reflects the light, greatly increasing the illuminating power of the lamp, chiefly in the direction of the longitudinal axis of the lamp. In the



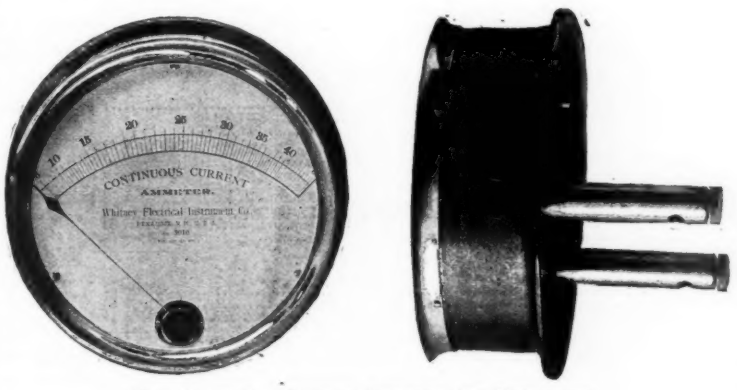
INCANDESCENT LAMP WITH INTERIOR MIRROR.

accompanying illustrations, *a* is the mirror and *b* are little nuts or other suitable devices which hold it in position on the leading-in wires.

The Whitney Electrical Instrument Company's Latest Products.

The accompanying illustrations show two of the most recent productions of the Whitney Electrical Instrument Company, of Penacook, N. H., in the shape of a round ammeter and voltmeter, which are fully in line with the well-known excellence of their other instruments.

They are striking in appearance, the cases being finished in black enamel with polished nickel trimmings, and being identical in form, add materially to the uniformity of



FIGS. 1 AND 2.—WHITNEY AMMETER AND VOLTMETER.

the switchboard. They are extremely accurate, being guaranteed to reach within one per cent of absolute accuracy, and indeed, making even a better showing under the exhaustive tests to which they have been submitted.

Being encased wholly in iron and hermetically sealed, they are not only thoroughly dust proof, but are unaffected by outside influences. They have an exceptionally long scale, with large clear divisions easily discernible from any part of the station.

Their latest instruments are the outcome of a long familiarity with the requirements of central station men, and embody all that such experience has demonstrated to be of the best.

The Whitney company have put several new instruments on the market within the past year, each one of which has marked a step in advance in instrument manufacture, and their latest effort is no exception to the rule.

Full particulars as to their capacity and other details will be cheerfully furnished by the company from headquarters in Penacook, N. H.

A Welsbach Deal.

The firm of Emerson, McMillin & Company, of New York, have made a contract with the Welsbach Light Company under which that firm will organize a corporation, which will be known as the Welsbach Commercial Company, that will act practically as a commission house, handling the products of the Welsbach company in the United States and furnishing the capital necessary for that purpose. The United Gas Improvement Company has sold to this Welsbach Commercial Company its shares in the Welsbach Light Company and in the Manhattan Incandescent Light Company, and will receive in payment therefor $1,000,000 in cash and more than one-half of the capital stock of the Commercial company, thus retaining unimpaired its present controlling interest in the incandescent gas-lighting business. The capital stock of the Welsbach Commercial Company amounts to $7,000,000, evenly divided into common and preferred shares.

LITERARY.

The publishers of *McClure's Magazine* announce, to begin with the July number, a reduction of price to 10 cents a copy and $1 a year. They explain that they are able to make a magazine of the highest quality at this price, and that they propose to give the public the benefit of this ability.

Scribner's Magazine for July contains several articles that are particularly adapted to the season—questions that interest people in early Summer. The leading article is "Life at the Athletic Clubs," by Duncan Edwards, who was a famous college athlete and has retained a keen interest in every form of athletic sport. His article has the advantage of being written by one who has a personal knowledge of the clubs which he describes in many large cities.

Mr. Robert C. Brown has resigned the position of electrical engineer of the Montreal Street Railway Company and accepted that of manager of the Halifax Electric Street Railway, Halifax, Nova Scotia. He is at present on a visit to his home in Boston, Mass., and will assume his duties in Halifax about July 15. The franchise of the Halifax company covers a street railway and lighting system.

Chicago & Northern Pacific has decided to equip its Chicago suburban service with electric motive power. It is understood that the company has been experimenting for sometime in this direction.

KIND WORDS.

"THE" ELECTRICAL PAPER.

TO THE EDITOR OF ELECTRICAL REVIEW:

Enclosed pleased find post office order ($3) for one year's subscription to *the* electrical paper of America.

Very respectfully yours,

P. E. F.

Saginaw, Mich., June 27, 1895.

GOOD VALUE RECEIVED.

A subscriber of the ELECTRICAL REVIEW, writing from Kingston, Jamaica, June 21, 1895, says: "Enclosed you will find $5—a very small return for the value I receive from the ELECTRICAL REVIEW. Your paper is the first read in my batch of papers from the States."

WESTINGHOUSE ANNUAL REPORT.

(*Concluded from page 21.*)

LIGHT AND POWER PROPERTIES.

Your company has for the past six years been interested in two important light and power properties, namely, the United Electric Light and Power Company, of New York, and the Brush Electric Company, Baltimore, Md. During the past year both of these companies, with the assistance of your company, have carried through financial plans which have put them on a prosperous business basis, and have given a large increase to the value of their securities held by your company.

The United Electric Light and Power Company, under the plan referred to, has acquired almost all of the stock of the Brush Illuminating Company and of the United States Illuminating Company, both of New York city, and is now completing and will soon have in operation one of the most comprehensive light and power stations in the United States. It has contracted with your company for 10 complete electrical outfits of 1,000 horse-power each, and for all the converters and other needed apparatus, half of these outfits having been used for the World's Fair lighting. On the completion of the above contract your company will have in securities of the United company,

1st Mortgage Bonds.....	$913,000
Preferred Stock.....	550,400
Common Stock.....	411,700

having already received of the above amount, under the terms of the reorganization, for material, unsecured notes, claims, and for a cash subscription of $200,000,

1st Mortgage Bonds.....	$748,000
Preferred Stock.....	187,500
Common Stock.....	411,700

From its old stations this company is now doing a business of about $800,000 per annum, which should be more than doubled by the revenue from the output of the new station, giving it a net revenue sufficient to pay interest on its bonds and dividends on all of its stocks, there now being a demand for light and power sufficient to absorb the entire capacities of the stations of all existing companies.

Brush Electric Company, of Baltimore, Md.—In the reorganization of this company your company subscribed for $40,000 first mortgage five per cent bonds and took in payment for machinery $170,000 first mortgage five per cent bonds, making your company's total holding $210,000 first mortgage five per cent bonds. Your company also was the owner and now holds 5,060 ($100) shares of the common stock out of a total of 7,292 shares outstanding.

The station of the Baltimore Brush company is new and is one of the finest to be found in the country. It has three of the World's Fair 1,000 horse-power engines and generators and has been supplied with a large amount of other electrical apparatus, and will be hereafter, as will also the United company, a constant purchaser of your company's apparatus and supplies.

The fields of operation of these companies are unusually profitable ones, and it is believed by your management that the value of the securities of both properties will, in the near future, be equal to or above their par value (amounting to $2,791,100) and that the final profit to your company on these securities will be a large one. (See Note.)

Outside of the profit your company will make from its interest in the United Electric Light and Power Company, of New York, and the Brush Electric Company, of Baltimore, your management anticipate a great addition to its business from the experience gained with these two companies and others in building light and power stations throughout the country, and the rebuilding on like lines of many antiquated plants, the managers of which are rapidly being forced to the conclusion that they can only continue to have a profitable business and successfully meet any competition that may arise by using multiphase alternating current generating apparatus directly connected with engine shafts whereby Tesla motor and all other services can be had from one class of machinery.

As stated in the last report, your company "has no contracts of any character with local lighting or other companies which can in any manner interfere with the sale of its apparatus."

The final closing of the World's Fair contract, and the cancellation of all the bonds given by your company for the faithful carrying out of the work, in connection with the profitable sale of the machinery used there, will make the following letter received from the president of the World's Columbian Exposition, Mr. H. N. Higginbotham, of interest to stockholders:

> WORLD'S COLUMBIAN EXPOSITION,
> Executive Department,
> CHICAGO, August 27, 1894.
>
> GEORGE WESTINGHOUSE, JR., ESQ.,
> President Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.:
>
> Dear Sir—It is with great pleasure that I hereby acknowledge the important work performed by your company in and for the World's Columbian Exposition.
>
> Your company installed in Jackson Park fourteen (14) dynamos, having a total capacity sufficient for operating 128,000 sixteen candle-power lamps; these dynamos operated both incandescent and arc lamps, as well as small motors. The entire capacity being equivalent to over seventy-five thousand (75,000) 16 candle-power lamps. Your company installed this plant complete, including distributing system, as well as inside wiring.
>
> Your contract required you to install, operate, maintain and remove your machinery; the task undertaken was one of great difficulty, as you were frequently delayed by the construction of other buildings and underground work by other contractors not being prompt in the execution of their contracts. The latter was done under very unfavorable conditions, owing to inclement weather, and the inside wiring was done hastily, as the position of lights could not be determined until shortly before the opening of the Exposition. Notwithstanding all these difficulties, the result of your work was fully up to our expectations and the requirements of your contract; and I take pleasure in certifying to the fact that the World's Columbian Exposition were in every respect fully satisfied, not only with the plant, but with the work performed, and the uniform gentlemanly and courteous treatment received at your hands as well as from your subordinate officers.
>
> For this work I beg to extend to your company the thanks of the Exposition management, as well as my own personal acknowledgment for the many courtesies received at your hands. With respect, I am, dear sir, very truly yours,
>
> (Signed) H. N. HIGGINBOTHAM,
> President.

Note.—The profitable character of the light and power business in large cities is indicated by present prices of the common stocks and bonds, which mostly are selling at a large premium.

COLLATERAL TRUST BONDS.

After full consideration of the subject, your board, under the powers conferred upon it by the company's charter, has authorized the issue of $1,250,000 ten-year five per cent collateral trust bonds, secured by certain bonds and stocks held by the company, provision being made in the Deed of Trust for the sale of a portion or all of the securities, and for the cancellation of the corresponding amount of the collateral trust bond secured thereby. It is proposed to fund out of the proceeds of this issue of collateral trust bonds an equal amount of debt, a greater part of which has been created in the building of the new works, the purchase of new machinery, and the outlays in connection with the financial plans of the United and Brush companies.

WESTINGHOUSE ELECTRIC COMPANY, LIMITED

Your company during the past year sold additional patent rights to the above company, and with the proceeds purchased the preferred and common stock of a number of English holders, so that your company now owns $782,500 preferred and $1,307,400 common stock (together, $2,089,900) out of $2,322,750 outstanding, and your company will hereafter direct all of its affairs. All apparatus sold by the London company has been purchased from your company at profitable rates, and the business of the London company has always been profitable, last year having netted nearly five per cent on a valuation of $1,000,000. It is proposed to push the business in Great Britain, continental Europe and in the various colonies, in order to increase the sales of your company's product, there having been many inquiries during the past year which your company has been unable to respond to, owing to lack of manufacturing facilities.

It is believed that the new prices which we have been able to make to the London company will enable its management to largely increase its sales and give a permanent value to all of your stock in that company.

PATENTS AND LITIGATION.

Your company, through its able counsel, has been successful in favorably terminating the litigation in respect to incandescent lamps, the feeder and main, and other important patents, and it was especially successful in the celebrated Bate Refrigerator case before the Supreme Court in which the life of a number of patents, wh'ch were being used to influence trade by your adversaries, was finally determined.

In the McKeesport case, argued in the Supreme Court October last, involving the ownership of the carbon burner for incandescent lamps, no decision has yet been handed down, but the long delay on the part of the court in arriving at a conclusion is regarded as not unfavorable to the sustaining of the claims of our Sawyer-Man patent.

To-day the most important inventions are those relating to the use of alternating currents, and your management believe that, with the exclusive control of the Tesla patents, its position in patent matters is more favorable than that of any or all of its competitors.

STREET RAILWAYS OPERATED BY UNDERGROUND ELECTRIC CIRCUITS.

Your company has secured the controlling interest in the stock of the Electro-Magnetic Traction Company of West Virginia, and through it the control of valuable inventions relating to the operation of street railway cars in large cities by means of underground circuits.

This system has been in continuous operation in Washington during the past year, and is now in successful operation on the tracks of your company in and about the buildings at East Pittsburgh, where it is to be used for moving freight cars and for general work.

This arrangement appears to be a complete solution of the problem of street car propulsion in all large cities, and should give to your company a large amount of additional business.

A model of this system is now in operation at our office at No. 120 Broadway, New York city, and will be exhibited to stockholders between the hours of 10 A. M. and 4 P. M. during July.

TESLA POWER DISTRIBUTING INVENTIONS.

Your company owns the exclusive right to manufacture and sell apparatus under the patents of Nikola Tesla, covering the use of multiphase alternating currents for power distribution. The rights under these patents are of great value, for developments indicate that it is only by means of Tesla's inventions that elevated and long lines of railways can be successfully operated, and that power can be most economically distributed over wide areas and throughout workshops. All of the machinery in your company's new factory at East Pittsburgh is driven by Tesla multiphase motors, and in such a successful manner that orders for like apparatus have followed its inspection.

The 5,000 horse-power generators contracted for by the Niagara Cataract Construction Company have been put in successful operation, and other important installations for power transmission under the Tesla patents have been made in various parts of the country.

Recently your company has fitted a short branch of the Pennsylvania Railroad with ordinary electrical apparatus for the propulsion of standard cars, and the tests have been entirely satisfactory. Your company is, however, pushing forward the manufacture of multiphase motors under the Tesla patents for practical tests in running standard cars on elevated roads and long lines, the success of which will be of especial importance, for it will insure to your company a large amount of trade for which your rivals will have no right to compete.

Suits under the Tesla patents are pending against the Stanley Electric Manufacturing Company, of Pittsfield, Mass., and the Thomson-Houston company. In the latter case on application made by attorneys of your company, the defendants have been limited to the 7th of October within which to close their testimony, it being the intention of counsel to push this and all cases of infringement to a hearing in order that your company may enjoy the exclusive privileges to which it is entitled.

While heretofore a very large percentage of the business of the country has been done by means of apparatus using continuous currents, it is now estimated by experts that the percentage will change so that in the near future the bulk of the business will be done by means of alternating current multiphase apparatus, involving the use of Tesla's important inventions.

CAPACITY OF NEW WORKS.

Our present room is sufficient for the employment of between four and five thousand men. The various buildings have been so arranged that the main workshop can be readily extended and the capacity of the works doubled at a comparatively small outlay without interference with regular manufacturing during building operations. Outside of the main buildings the others already have the required capacity, and there is still available for further buildings fully one-half of the forty acres owned by the company.

The indications are that the demand for electrical apparatus in general will be greater during the next 12 months than for any like period in the past, and it is therefore a matter of great importance that our new works are now in complete operation.

Very respectfully,
GEORGE WESTINGHOUSE, JR.,
President.

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY'S BALANCE SHEET, MARCH 31, 1895.

ASSETS.

Cash in banks			$202,880 89
Bills receivable			80,133 81
Accounts receivable			2,140,131 10
Material in stock and in process of manufacture (at cost of labor and material)			2,120,227 95
Advances to leased companies			149,588 20
Bonds (par value $866 206,17)			811,271 38
Stocks (par value $8,656,009,72)			4,092,519 40
Real estate and buildings, Pittsburgh			464,403 48
New factory—Land and buildings		$1,186,750 22	
Less—First Mortgage on land and buildings (final payment due April 1, 1900)	$400,000		
Second Mortgage on land (final payment due April 1, 1896)	115,000		
First Mortgage second purchase of land (due July 1, 1899)	59,300		
		574,300 00	
Total			612,450 22
Machinery and tools			1,159,842 44
Miscellaneous			70,292 77
Charters, franchises and patents			4,404,499 45
			$16,314,241 09

LIABILITIES.

Accounts payable			$403,017 02
Bills payable, issued for merchandise			379,222 36
Discounted with collateral			1,265,000 00
Contract and Contingent Liabilities:			
Scrip dividend			194,560 00
Stock subscription			13,125 00
Collateral trust bonds			250,000 00
United States Electric Lighting Company's six per cent 15-year bonds $50,000 payable annually			500,000 00
(Bills receivable under discount, $396,972.37.)			
Capital Stock:			
Preferred, 79,865.31 shares		$3,993,265 50	
Assenting, 104,779.02 "		5,188,951 00	
Common, 2,954 "		147,700 00	
			9,329,916 50
(In Treasury, 13,266.98 shares Assenting and 134.69 shares Preferred.)			
Surplus			3,979,400 21
			$16,314,241 09

SURPLUS.

Surplus balance, March 31, 1894			$3,822,049 38
Twelve months' net earnings from business	$734,698 85		
From other sources	67,710 37		
		$802,409 22	
Less expense applicable to moving factories		90,499 54	
			711,909 68
			$4,533,959 06
Less amounts written off in adjustment of matters pending prior to current year		$78,031 86	
Adjustment and depreciation in current year		133,408 00	
			211,439 86
			$4,322,519 20
Interest on bonds and mortgages		$57,386 61	
Interest on scrip		11,673 60	
Dividends paid		274,058 78	
			343,118 99
Surplus balance, March 31, 1895			$3,979,400 21

The new plant of the State Electric Light and Power Company, at the foot of South Ninth street, Brooklyn, N. Y., was thrown open to the public on the evening of June 29, when an exhibition of lighting was given by Edwin Reiber, the chief electrician of the company. In the building there were 300 incandescent and 125 arc lights burning. The plant cost $246,000. There are two 300 horse-power engines and four "Wood" dynamos, two arc and two incandescent. The capacity of the plant is 300 arc lights and 6,000 incandescent. The directors of the company are: Noah L. Cocheu, president; Col. Lewis R. Stegman, vice-president; William Seward, treasurer; James Niblo, Jasper N. Raymond; John Tregaskis, secretary.

NOTES ON THE RECONSTRUCTION OF A SMALL CENTRAL STATION PLANT.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NIAGARA FALLS, JUNE 27, 1895, BY FRANKLIN L. POPE.

The financial condition of the smaller central station electric lighting plants throughout the country is at the present time by no means satisfactory, and in too many instances cannot even be truthfully said to be encouraging. A survey of the field shows that very few such plants located in towns having less than 10,000 inhabitants are earning more money than is necessary to meet their operating expenses and to provide for indispensable current repairs. In the State of Massachusetts, in which the operations of all electric lighting companies are by law made a matter of public record, it appears from the latest reports that the aggregate liabilities of the 57 companies operating in that State, including stocks, bonds and floating indebtedness, amounted on June 30, 1894, in round numbers to $14,000,000, nearly all of which stands charged to construction account. The net earnings for the preceding year were $1,000,000, or about 7.1 per cent on the total investment—a sum obviously quite insufficient to provide for depreciation and at the same time pay a fair dividend on the capital which has gone into the business. But if half a dozen of the larger plants, in cities like Boston, Lowell, Worcester, Springfield, Lynn and Fall River, were excluded from the list, the showing for the smaller plants would be even far worse than it now appears.

Many of these small plants were started at an earlier day than could have been justified by any reasonable estimate of the business then in sight, and now find themselves hampered by inconvenient buildings and with unsuitable machinery bought at high prices and encumbered with defective business methods, which experience has shown to be wholly inconsistent with the dictates of good judgment.

With the owners of many of these plants, it has become a very serious question whether the easiest way out of the dilemma which confronts them may not be to relegate the entire plant to the junk shop and the scrap-pile, and commence over again with new buildings, modern machinery and improved methods of administration. When the necessary capital is readily forthcoming, there can be no doubt that this would often be the wisest course of procedure, but for obvious reasons it is one which is not always nor even usually practicable. The alternative is to remodel the existing plant, bringing it as nearly as may be into accordance with the best modern practice, and utilizing so far as possible the old material; a course which at least has the merit of avoiding an undue expansion of the construction account; in most cases already sufficiently burdensome.

Having been called upon during the past year to advise the owners of a plant of the character above referred to, in reference to certain changes which had been suggested as desirable, and having afterwards been employed in a professional capacity to design the work and superintend its execution, I have thought that some account of what we undertook to do, and how we did it, might not be without interest to the members of the Institute.

The Great Barrington, Mass., Electric Light Company was organized and commenced business in 1888. The population of the district intended to be served was about 3,000, and most of the expected consumers were located within 2,000 feet of the point decided upon for the station. This was built of wood in the most inexpensive manner possible, and was placed alongside the railroad for convenience in receiving coal, although at the same time the danger from fire was materially increased.

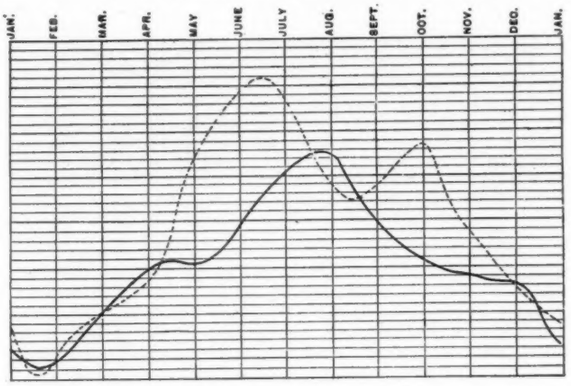


FIG. 1.—Curve of mean annual distribution of rainfall. Full line is reduced observations at Williamstown, Mass., 1816 to 1874. Dotted line is mean of all observations in the Hudson and Champlain Valleys, and Northern and Western New York, aggregate 564 years.

The original outfit was an Edison three-wire, equipped with a pair of 250-light 110-volt dynamos, and the company commenced business with 281 lights on contract at $10 per year each; wiring free. The center of distribution was 1,800 feet from the station, necessitating over a ton of copper in the feeders alone. Generally speaking, the plant was well laid out and well built, as things went in those days. The two dynamos were belted to a single 80 horse-power Armington & Sims engine. The original cost of the plant was about $16,000. The following year a Schuyler arc plant for street lighting was added, carrying 35 arcs, nominally of 1,500 candle-power, which was run from the same engine and boiler. In 1890 the plant was considerably enlarged by the addition of a second arc machine, a Westinghouse 500-light alternator, and a second engine and boiler of the same capacity as the first. An 80-kilowatt Westinghouse dynamo of more modern type was afterwards substituted for the original one.

Upon examining the plant last year I found the Edison machines carrying on Saturday evenings a maximum load of some 450 lights, while three evenings in the week (with the stores closed) it fell to perhaps half that amount. The two Schuyler machines, with an aggregate capacity of 55 to 60 lights, were carrying about 38 to 40, or an equivalent of that amount, while the Westinghouse machine was seldom as much as half-loaded, carrying a maximum of possibly 500 lights during three or four months of the Summer season, and not much more than one-fourth that amount the remainder of the year. Necessarily, with so many dynamos of different types and with such a variable, yet small, average output, the consumption of coal was excessive as compared with the light delivered and paid for.

The street lines, according to the usual practice, were of No. 6 Brown & Sharpe weather-proof wire; the poles were of cedar of good size and fitted with pine or spruce cross-arms, with common green glass insulators set upon wooden pins. In consequence of a silly prejudice, which had been fomented amongst the citizens by interested parties against permitting poles to be set in the streets, the wires, in a very great number of instances, had been attached, by cross-arms or brackets, to the trunks of the immense elm trees with which the streets of the town were shaded; a practice which occasioned an enormous loss of current every wet night as well as much irregularity in the performance of the lights. The effect on the trees was by no means salutary, while the appearance was as much worse than that of poles in the streets as could possibly be imagined.

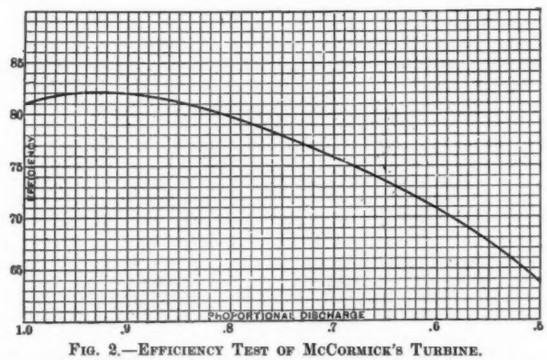


FIG. 2.—EFFICIENCY TEST OF MCCORMICK'S TURBINE.

The village of Great Barrington extends for the most part along a single broad thoroughfare for a distance of nearly three miles, and the street-lighting circuits are consequently very straggling. The 1,500 candle-power lamps, which were suspended at intervals of 800 to 1,000 feet, were actually of very little service in illuminating the densely shaded streets.

After a careful consideration of the situation, keeping in view the greatest possible reduction of present and future operating expenses, it was determined that the wisest course to pursue would be to consolidate the whole service so that it could be supplied by one dynamo, in place of five underloaded ones. In pursuance of this plan it was decided to adopt the two-phase alternating system, at a maximum pressure of 2,100 volts in the primaries, and 105 volts in the secondaries, with a frequency sufficiently low to permit the advantageous use of induction motors if required. It was furthermore decided to abandon the steam plant, and to make arrangements to utilize some one of the excellent water-powers which were available within practicable distances. Under ordinary circumstances, I should have hesitated to recommend the substitution of water-power for steam as the sole source of power for the operation of an electric lighting plant. Water-power is an invaluable auxiliary, and when conveniently available for use in conjunction with steam, may often be made to save a very large coal bill in the course of a year. On the other hand, the excessive fluctuations to which it is subject—which are scarcely realized by those but casually acquainted with the subject—render it in most cases a very uncertain reliance for a business which is compelled to go on, perforce, every night in the year, and which cannot suspend operations, as an ordinary manufactory does, if worst comes to worst, for a week or two at a time. Even a water privilege which, during 10 months of the year, furnishes twice as much power as is needed, and even more, may be expected to fall off, during one of the extraordinarily dry seasons which occur at intervals of from five to ten years, to one-third its usual amount. In such a case an electric plant solely dependent upon water-power would find itself in a most undesirable predicament.

In the present instance, the choice of a water privilege finally reduced itself to two sites, one in the town itself, within half a mile of the center of consumption, and the other at Glendale village, seven miles distant, both situated on the Housatonic River. The privilege first mentioned being already occupied by a woolen factory, only the surplus water was available, but this was known to be quite sufficient for the requirements of the electric company at least nine months in each year, leaving three months to be run by steam. It had the advantage of being close at hand, and was capable of being fitted up at a moderate cost. As to the Glendale privilege, it was necessary to be very sure that the lowest water of a dry Summer would give all the power required to run the plant without the aid of steam. Having invariably found the value of a water-power to be greatly exaggerated, not only in popular estimation, but in the opinion of its owners, the matter was investigated with much care. From the official State map of Massachusetts, it was ascertained that the area of the drainage basin of the Housatonic above the Glendale dam was 269 square miles. J. T. Fanning, a leading authority, from an extended examination of the recorded observations on the rainfall and flow of the New England rivers, reaches the conclusion that a watershed of the area mentioned may be estimated to yield the quantities of water given below:

CUBIC FEET OF WATER PER SECOND PER SQUARE MILE.

Minimum (15 days of least Summer flow)	0.25
Mean (120 days, usually July to October, inclusive)	0.90
Maximum (flood volume)	93.00

It will be noticed that the flow in extreme dry weather is less than one-third of that which may be depended upon through the remainder of the year.

The distribution of rainfall throughout the year should be studied. It is often materially modified by local

geographical conditions. The diagram shows that the distribution on the headwaters of the Housatonic is quite different from the normal type of the northeastern region. The same may be true of other rivers.

While this investigation was going on, it was discovered that actual measurements of the volume of water in the Housatonic River had been made in 1878 by the engineers of the New York Department of Public Works, with reference to its utilization as a future source of water supply for that city. The minimum Summer flow was found to be (as given in the engineer's report) 0.34 cubic foot per second per square mile. It was also learned that measurements made on several different occasions at Birmingham, Conn., in very low stages of water, gave an average of 0.32 cubic foot per second per square mile. It was, therefore, assumed that Mr. Fanning's estimates were at least on the safe side. The greater volume of water found by the actual measurements is doubtless due to the fact that there are some five or six square miles of reservoirs, consisting of natural and artificial lakes, on the upper waters of the Housatonic, which are drawn upon by the numerous mills on the river as an extra supply during the season of drought.

A minimum flow of 0.25 cubic foot per second per square mile would give at Glendale 4.035 cubic feet per minute. Multiplying this by the weight of a cubic foot of water (63.3 pounds) gives 255,415 foot-pounds, which, divided by 33,000, gives 7.74 gross horse-power per foot of fall, or a total of 99.6 horse power for the 13 feet fall at Glendale. The average efficiency of a good turbine may safely be taken at 75 per cent, which would give 67.9 as the available horse-power during the whole 24 hours, in time of lowest water. In electric lighting, however, the great bulk of work is done within a period of about four hours (in Summer time), and hence it is possible, in case there is sufficient area of pondage above the dam, to increase this capacity by storage at least four-fold, which would raise the limit of minimum available power during lighting hours to 271.6 horse-power, an amount which was considered to be ample to meet all the probable requirements of the Great Barrington plant for many years to come.

While negotiations were still pending with the owners of the Glendale privilege, and also the one in the village already referred to, overtures were received from a manufacturing company owning a third exceptionally desirable privilege on the same stream at an intermediate point considerably nearer than Glendale. This company had only recently completed a new dam, head-gates, raceways, etc., at a very considerable expense and was willing to lease the complete establishment, including a new McCormick turbine of 325 horse-power and a two-phase Stanley generator of corresponding capacity, at a monthly rental based upon the actual output as measured in kilowatt hours at the dynamo terminals, provided that a certain minimum monthly consumption was guaranteed. With the same volume of water as at Glendale, the fall at this point was 20 feet, assuring at least 417 horse-power at lowest water during lighting hours. All the hydraulic apparatus and appointments were of the best possible construction and well-calculated to insure absolute permanency of operation.

The minimum rental required was somewhat less than the amount of the coal bill of the Great Barrington company for the preceding fiscal year, but, while the immediate saving in operating expenses was not large, the acceptance of the proposition would place the company in a position to reduce its rates to consumers, for the reason that its output might be very largely increased without materially augmenting its operating expenses. A lease for a term of years was accordingly closed.

In laying out the plant it was determined to bring the main feeders directly to a distributing station in the village, to be used principally as a convenient headquarters for testing the circuits and controlling the street-lighting service. In laying out the transmission line, a surveyor was employed and a preliminary line was run directly from the power house to the distributing station. The air-line distance was found to be 5.15 miles. With the assistance of the surveyor the actual line was then staked out, going directly across country and keeping as near as circumstances permitted to the transit line. About half the distance the transit line was found to so nearly coincide with existing highways that the consent of the local authorities was obtained to set the poles along the highway location; the remainder of the route lay principally through uncultivated land of little value, so that a comparatively small expenditure was sufficient to secure a release from all claims for land damages. This enabled the line to be located with long stretches absolutely straight, avoiding all sharp angles, a very important consideration when heavy wires are used. The poles were of selected chestnut with natural butts, usually set five feet in the ground at maximum intervals of 125 feet. The poles were ordinarily 25 feet long and eight inches thick at the small end. Shorter poles were sometimes used on elevations and longer ones in depressions, in order to equalize the strain as much as possible. The insulators used were of the large double-bell white porcelain type (German government standard), and were imported by us from Berlin. The insulator of the top wire is set upon a malleable iron stem 14 inches long screwed into the top of the pole, which is tapered to five inches diameter and protected from splitting by driving on a wrought-iron ring. The tapered part of the pole, as well as the top, was given a coating of mineral paint mixed as thick as it could be spread with a brush. The insulator of the second wire is carried on a malleable iron goose neck, screwed into a five-eighth-inch hole bored in the side of the pole, in such position as to bring the wires about 16 inches apart. Another hole was bored on the opposite side of the pole, intended to take the goose neck of the third wire at some future time, leaving the same interval between the second and third wires. The porcelain insulators are fixed to their iron supports by a packing of oakum placed between the screw threads, which serves to prevent any danger of breakage by expansion or contraction. The line wire is laid in a groove formed in the top of the insulator, except upon the curves and angles, in which case it is tied at the side in a circumferential groove, as is usual in this country. The German method of tying is quite complex and unnecessarily strong; in case of undue strain, if anything gives way it had best be the tie wire. We therefore devised a simple tie which was easily and quickly applied and which has so far served an admirable purpose. We were obliged to string the wires during very cold weather; sometimes as cold as eight or ten degrees below zero, and hence it was necessary to strain them very tight. A block and fall and a well-trained horse were used in pulling up, usually six or seven spans of one wire at a time. The hook of the block was always attached to the copper wire, whether bare or insulated, with a chain knot made of three-quarter-inch rope. The feeder wires were of No. 3 Brown & Sharpe soft copper, covered with weather-proof "insulation" along the highway (as a concession to enlightened public opinion), but elsewhere bare. The lengths of wire were joined with McIntyre twisted couplings; the unusual strain we had to put upon them occasionally pulled one apart, and this led us, out of abundant caution, to solder them, although this was done for mechanical rather than for electrical reasons. Only two feeder wires have as yet been strung, providing for a single-phase current from one side of the two-phase generator, but it is the intention to run a third feeder hereafter, which will enable two-phase induction motors to be connected to the same distributing system.

A pair of telephone wires of No. 12 steel were strung below the feeder wires, and these were supported upon small German porcelain insulators on iron goose necks on opposite sides of the poles. These wires were transposed at intervals of about a mile, in order to eliminate the inductive effects of the alternating current in the feeders. The feeder lines were carried under the railroad at an undergrade crossing by placing the insulators upon iron brackets leaded into the stone abutments. The plan of construction above described makes a strong, handsome and durable line, while the insulation of the circuit, even in the worst of weather, is simply faultless.*

The system has been planned to deliver the current at the distributing station at a uniform pressure of 2,100 volts. Two distributing centers were fixed upon in the old Edison three-wire network, and at each of these points a pair of large transformers, having a ratio of 20 to one, were fixed upon a pole, with their respective primaries in series between a pair of branch feeders from the distributing system, and their secondaries were coupled in series in like manner with the neutral wire between them. None of the consumers on the old Edison system knew when the change had been made to the new service from anything they were able to notice in the behavior of the lights.

The next thing done was to reconstruct the street-lighting system. In place of the 36 arcs of 1,500 nominal candle-power formerly in use, we substituted 126 incandescent lamps of 50 volts and 32 candle-power, placed in Iona fixtures projecting horizontally from the poles 14 feet above the ground. The lights, as a rule, were fixed upon every alternate pole, but in the business center, the street being broad, they were placed on each side at intervals of about 250 feet, and staggered, so as not to come opposite each other. A Shallenberger shunt cut-out was applied to each lamp. The usual number of lamps in each circuit was 42, although we have since placed, in some cases, as many as 47 in one series without reducing the brilliancy of illumination sufficiently to be noticeable by any one but an expert. One end of each street-lighting circuit is joined to a special feeder leading to the substation, where it is connected with the main feeder through a knife-switch. The other end of each lamp-circuit is connected to any conveniently located branch feeder of the regular commercial lighting service. Each lamp circuit has, or will have, a fuse block and cut-out enclosed in a weather-proof box at each end, where it joins the opposite feeders. These 32 candle-power lamps, when run at full candle-power, furnish a most satisfactory illumination and give the streets a very attractive appearance. So far as possible each lamp was located with the aid of a transit and level, so as to get them in absolutely straight lines both vertically and horizontally, a precaution which adds materially to the decorative effect. It is admitted by all that the streets of the town are much more satisfactorily lighted by the incandescents than they formerly were by the arc lamps, while the actual cost to the company is considerably less. The new lamps were cut in, one at a time, on the old arc wires, jumpers being temporarily placed across the terminals until everything was in readiness to discontinue the use of arc machines.

One of the most marked advantages of the series street-lighting system, especially when shunt cut-outs are used, is its great flexibility and convenience. For example, instead of placing from 40 to 45 50-volt lamps in one series, we may use 20 to 23 100-volt lamps, or if an odd number be required, less than is necessary to make up a circuit, the deficit may be supplied by adding extra shunt boxes in series at any convenient point in the circuit, until the pressure has been reduced to the required point. From time to time, as new lights are added, these spare shunt-boxes are one after another brought into use in connection with them. Sometimes, also, we temporarily install extra street lights by connecting them in parallel to the secondary mains of the regular commercial service, ultimately transferring them to new series circuits.

It has been found to be desirable to use a lamp of rather low efficiency for the street-lighting service, as there is always danger of leakage and short circuits from wet boughs of trees and other objects getting into contact with the wires, and thus diverting an abnormal current through some portion of a lamp circuit. In such case, a lamp of high efficiency is pretty certain to be burned out, or at least to have its career of usefulness materially abridged. In this plant, the average consumption of energy in the street lights, including lamps, lines, shunts and leakage, is found to be about 140 watts per lamp of 32 candle-power.

Perhaps the most ticklish part of the whole undertaking was the changing over of the Westinghouse system, which was a 1050-volt primary and a 52-volt secondary, running at 16,500 alternations. In accordance with the new plan, it was of course necessary to double the pressure both in the primary and secondary circuits, and to substitute 104-volt for 52-volt lamps throughout. A preliminary test of one of the transformers demonstrated that which, perhaps, might have been foreseen from theoretical considerations, viz., that a dangerous quantity of heat was developed within a few hours when it was used to convert from 2,000 volts down to 100. In order to utilize, so far as possible, the old transformers, and at the same time avoid the above difficulty, various

*I regret that I am unable to present any actual measurements of the insulation of the line of the Great Barrington company, no opportunity having occurred since the work was completed, of making tests under atmospheric conditions of minimum insulation. Several years ago, however, while engaged in telegraphic service, I made a series of nearly 100 separate tests in rainy and foggy weather, extending over a period of five years, of a set of 10 porcelain insulators of the same make and pattern in every particular as those now on the Great Barrington line, erected on a house-top in the city, and therefore much exposed to smoke and dirt. These measurements gave a mean resistance 28.3 megohms, and a minimum resistance of 19 megohms per insulator. On a metallic circuit therefore, the minimum insulation resistance at each pole would be 38 megohms. On the Great Barrington line of 28,260 feet there are 250 poles and other supports, and hence we may assume that the minimum resistance of the insulation of the circuit as a whole would be 152,000 ohms. The current loss by leakage is found by dividing the mean voltage by the insulation resistance; $\frac{2,200}{152,000} = 0.014$ ampere; an amount too small for serious consideration.

expedients were resorted to. Wherever a group of consumers was located in one neighborhood, a pair of large transformers were installed, with secondary mains extending from 500 to 600 feet in various directions; these transformers being of course placed in series with each other. Scattering consumers, as far as practicable, were connected together in small groups, and supplied by a pair of small transformers coupled in the same way. The Westinghouse meters, having been originally constructed for a frequency of 16,500 alternations, ran slow when the frequency was reduced to 8,000. The necessary coefficient for correction of the readings was easily ascertained by experiment, and as fast as possible the meters were fitted with new disks, supplied by the Westinghouse company at a trifling expense, and adapted to the lower frequency.

Of course, it will be understood that the reason for resorting to these various shifts and expedients was merely that we might utilize the old apparatus as far as it could possibly be done and also that we might carry on the work of reconstruction, for the most part, with the ordinary working force of the establishment.

The horizontal double turbine, which is used to drive the two-phase generator, has done such good work that it deserves a few words of commendation. The selection of the best among the many available types of turbines for electric work is a matter which merits far more consideration, from a scientific standpoint, than it generally receives. Water-wheels, like dynamos and motors, are sometimes sold on commission by agents, and it not infrequently happens that the salesman who makes the largest "claims," especially if he sells his goods the cheapest, carries away the contract. It needs to be said, however, that there is a far greater difference than is often suspected in the amount of work different types of wheels will do with a given, and especially a limited, amount of water. There are, furthermore, a great many types of wheels in the market, which, although as efficient as could be asked for with a full volume of water, are very far from being so when the volume of water is reduced, even by a comparatively small percentage. It is but just to say that it is seldom that a turbine makes so favorable a showing, not only in this but in other respects, as the one provided by the company from which we lease our power. The following figures are selected from a much larger number obtained by actual measurement of its performance in the testing flume of the Holyoke Water Power Company:

Head acting on wheel feet.	Revolutions per minute.	Quantity of water passing through wheel (cubic feet per second).	Horse-power.	Per cent of efficiency.
16.66	156.25	81.75	124.50	80.99
16.80	155.00	70.79	109.37	81.18
17.02	154.50	63.42	95.86	78.39
17.26	156.75	52.19	73.42	71.95
17.44	152.25	42.55	53.71	63.90

These results are worthy of particular note, for the reason that they show a very high percentage of efficiency maintained through a wide range of variation in the quantity of water passing through the wheel, a most valuable characteristic for electric work. When the quantity of water used was diminished from 81.75 to 42.55 cubic feet per second the percentage of efficiency fell only from 80.99 to 63.9, and what is even more remarkable, it was found that the efficiency remained well above 80 per cent over a range of variation of discharge from 83.22 to 70 cubic feet per second or 15.9 per cent. More than one type of turbine which enjoys a high reputation and extensive sale among manufacturers will not reach 65 or even 60 per cent efficiency at "three-quarter gate," while the 33-minute wheel above referred to has been found to give by actual test 78 per cent under similar conditions.

The turbine carries upon its shaft a driving-pulley 100 inches in diameter, weighing 11,000 pounds, which serves as a balance wheel. It is also provided with a Replogle electric governor operated by three cells of gravity battery, which has never failed to do its work quickly and certainly, even under trying conditions.

In carrying out this work, some things have been learned by experience which may be of use to others called upon to advise or to undertake the construction of similar works, and I will therefore venture to summarize some of my conclusions as follows:

1. In considering the advisability of operating an electric plant by water-power do not on any account, neglect to ascertain from authentic sources of information, just how much water can be depended upon during the low stage in an extra dry year, for this is the measure of its value for electric work, except when used as an auxiliary to steam. The ordinary estimates of the commercial value of a water-power are only too apt to prove preposterous exaggerations.

2. If rights-of-way or releases of damages can be obtained without too much trouble and expense, it is better to build the feeder line as directly across country as may be, than to follow a highway. The saving in cost of construction will usually be more than enough to pay for the right-of-way, and on such a route there need be no interference from trees, while many inconvenient angles and much trouble in guying and bracing are avoided. Shorter and stouter poles may also be used; in itself a very important consideration.

3. In electric line construction it is preferable to dispense with cross-arms, unless there are more than six wires. The best arrangement is to place one wire on a top pin and the others alternately on the front and back of the pole, at a vertical distance apart of 12 inches. This construction not only costs less than properly braced cross-arms, but in much less conspicuous and therefore much less objectionable in a public street; is less interfered with by trees; and is far more durable. Much trouble is caused by the decay of cross-arms after they have been exposed a few years to the weather; they split at the ends so that the pins come out, and not infrequently break in the middle, thus fouling the wire.

4. In medium-sized towns and cities, especially in shaded streets, the incandescent lamp may be made to give a far better distribution of light for the same money than is possible with the "half-arcs" so extensively used, and is much less troublesome to maintain in good working order. My own experience leads me to think that the lamps ought not to be of less than 24 or more than 32 candle-power. Use lamps of low rather than high efficiency, but run them at full candle-power, or even a trifle above. Good street lights, well arranged, and renewed sufficiently often, are the best possible advertisement for any electric company.

5. Use large transformers as far as practicable, placing the consumers within 500 or 600 feet radius upon secondary mains. We have used both two-wire and three-wire mains. The latter plan is certainly to be recommended when the distance approximates or exceeds 500 feet, but for short distances, as for example, when distributing within a single block at a pressure of 100 volts or more, it is a question whether the gain in cost of copper over the two-wire plant is of sufficient importance to offset the additional complexity.

6. It was found that raising the voltage in the residence district from 1,000 : 50 to 2,000 : 100 greatly improved the uniformity of distribution by lessening the potential drop without entailing any corresponding disadvantages. It would seem to be preferable, on every account, to use the higher pressure.

7. One of the most important minor points in the management of a plant is apt to be too much neglected; the maintenance of the insulation of the wires by promptly replacing all cracked and broken insulators, and by keeping the wires absolutely free from contact with uninsulated objects. The covered wires which lead into the hoods of the street lamps need to be carefully looked after.

8. Number all the poles with yellow paint applied with a stencil on a black ground; and keep a record book of the position of each one and its distance by the line from the test station.

9. In selecting a turbine wheel, consult competent authorities as to the available fall and minimum quantity of water, and when making the purchase do not expect to get a $1,000 wheel for $100. Pay a fair price and insist not only that the wheel shall be well made in every way, but that it shall be tested by an expert before acceptance. If it does not give an average efficiency of 76 per cent between half-gate and full-gate, it is not advisable to accept it, inasmuch as you can easily do better, as our own experience proves.

10. I think our experience shows that it is possible to largely increase the net earnings of an old plant without necessarily refitting it throughout, but plenty of time should be taken for consideration as well as for execution in order to secure satisfactory results with a moderate expenditure.

BOSTON NEWS.

The American Circular Loom Company have just shipped the last of two big orders for flexible conduit, one comprising the entire equipment for the St. Charles Hotel, in New Orleans, and the other for the Cliff House, in San Francisco. The business of this concern has been steadily on the increase for a long time, which is in no way surprising, as the merit of the goods themselves and the popularity of the men who represent them is a combination which wins.

Bibber, White & Company, of this city, are doing a splendid business in the products of the Crefeld Electrical Works, of which they are the selling agents, and, in spite of the unsatisfactory state of the wire business in general, are selling lots of goods, and, what is fully as important, are getting good prices for them. The factory is kept pretty well busy on high-grade magnet wires, and some exceptionally heavy orders have recently been booked. The lead-covered cables manufactured by this concern are also meeting with a ready market, and they are daily demonstrating that a good article will always command its price. H. G. T.

Boston, July 3.

OBITUARY.

George F. Gregory, a director of the Edison Electric Illuminating Company, of New York, died at his residence in Brooklyn, N. Y., on June 29, in his 57th year. He was actively interested in the Standard Oil Company and other large corporations.

An offer was made to the Electric Storage Battery Company last week by a house in New York which controls the fire alarm system in 800 cities and towns, guaranteeing to take annually 1,000,000 cells providing the company gives it exclusive rights of the battery for fire alarm purposes.

Trunk wires to connect London by telephone with Edinburgh, Glasgow and Dublin have just been erected by the British Post Office.

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ADVANCE INFORMATION.

VALUABLE INFORMATION FOR MANUFACTURERS AND DEALERS.

We publish below the earliest information obtainable relating to new electric railways, new electric light companies, new telephone companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW from week to week.

New Manufacturing Companies.

DALLAS, TEX.—The Electric Protection Company has been incorporated by Charles Goldstein, Henry Hirsh and William H. Garretson to supply electric devices for the protection of vaults, etc. Capital stock, $50,000.

CHICAGO, ILL.—Bullard Electric Company; incorporated by Charles W. Bullard, Albert S. Bullard and Carl F. Kammeyer with a capital stock of $25,000.

CHICAGO, ILL. — American Synthephone Company has been incorporated; capital stock, $1,000,000. To manufacture electrical appliances. Incorporators, William S. Adams, Asa G. Adams and Louis M. Stone.

CHICAGO, ILL.—Elliott Magnetic Electric Company has been incorporated; capital stock, $1,000,000. Manufacture magnetic and electrical appliances. Incorporators, William R. Elliott, Isaac C. Robbins, Charles A. Emmons.

CHICAGO, ILL.—Electric Wire Hanging Insulator Company has been incorporated; capital stock, $200,000. Incorporators, Edgar O. Baker, William A. Robertson and Henry W. Rice.

CHICAGO, ILL.—Cosmelectric Company has been incorporated; capital stock, $10,000,000. Manufacture electrical apparatus. Incorporators, Bassett Cadwallader, Charles O. Barnes, Nahum C. Jamison.

Business Troubles.

LOGANSPORT, IND.—The Logansport Street Railway has passed into the hands of a receiver.

Increase of Capital Stock.

PITTSBURGH, PA.—The Electric Messenger Company has increased its capital stock from $25,000 to $500,000.

PEKIN, ILL.—The City of Pekin Electric Light and Power Company certified to increase of capital stock from $15,000 to $50,000.

New Telephone and Telegraph Companies.

BARBERTON, OHIO.—The Magic City Telephone Company has been incorporated by W. S. Holloway, John McNapara, F. G. McCauley, George A. Shaw and others.

NEWARK, N. J.—The Newark Mutual Telephone Company has been incorporated by Ernest J. Ford, of Jersey City; P. J. Atkinson, of New York city; and Samuel I. Boyd, of Brooklyn, N. Y. Capital stock, $300,000.

APPLETON, MO.—The St. Clair Telephone Company has been incorporated by O. E. Robinson, J. M. Burns.

FREDONIA, KAS. — Fredonia Telephone Company has been incorporated by Charles L. Morton, F. W. Severson, A. C. Flack, G. S. Paulen and Atwood Cady. Capital stock, $5,000.

FRAMINGHAM, MASS. — The Framingham Telephone Company has been incorporated to furnish a telephone service in Framingham and Natick, with a capital stock of $15,000.

WACO, TEX.—A franchise to the Mutual Telephone Company to construct and operate a plant in this city has been granted.

CHAMBERLAIN, S. D.—Preliminary steps have been taken toward the construction of a telephone line from he town of Port Pierre to Midland.

BOONE, IA.—County Telephone Company has filed articles of incorporation. The amount of capital authorized is $10,000. The incorporators are A. A. During, Chas. E. Wells, R. G. Schaaf, J. L. Stevens, W. H. Crooks.

LAURENS, S. C.—A charter to the Laurens Telephone Company has been granted. The officers of the company are: Directors, J. F. Traynham, B. F. Posey, J. H. Sullivan, E. H. Wilkins, W. R. Ritchie and O. B. Simmons; president, J. H. Traynham; vice-president, B. F. Posey; and secretary and treasurer, W. R. Ritchie.

ST. JOSEPH, MO.—A telephone line is to be built between Hutchinson and Nickerson, Kas.

ASTORIA, ILL.—Astoria Telephone Company has been incorporated; capital stock, $2,500. To operate a telephone line. Incorporators, A. J. Baxter, J. H. Windherst, J. M. Todd, T. F. Emerson, H. F. Farwell.

MIDDLETOWN, N. Y.—The Sullivan County Telephone Company will extend its system from Liberty to Liberty Falls, Strongtown and on to Monticello.

SUSQUEHANNA, N. Y.—There is a movement on foot to establish a telephone line between this place and Deposit, *via* Stevens' Point and Ouquaga Lake.

ABERDEEN, LA.—A telephone service is being established here and will be in operation by July 1.

READING, PA.—The Philadelphia, Reading & Pottsville Telegraph Company has elected Joseph S. Harris, president; W. A. Church, treasurer; W. R. Taylor, secretary.

HAMBURG, ARK.—Articles of incorporation of the Hamburg & Portland Telephone Company have been filed. The incorporators are J. D. Pugh, Charles M. Woodward, J. H. Pryor, T. R. Pugh and T. B. Savage. The capital stock is $3,000. The object of the company is the construction of a telephone line between Hamburg and Portland in Ashley County.

JACKSON, GA.—A telephone exchange is to be established here. Mr. S. B. Kinard is the promoter of this enterprise.

ALBANY, N. Y.—The Albany District Telegraph Company has been incorporated to conduct a messenger service; capital, $20,000. Directors: Selden E. Marvin, D. Cady Herrick, James H. Manning, Henry E. Hawley, F. W. Newman, W. F. Wieser and J. J. Wieser, of Albany.

RALEIGH, N. C.—A long-distance telephone will be erected between this place and Hamlet. Chas. E. Johnson is interested.

Electric Light and Power.

MONROVIA, CAL.—A local company has been organized to furnish electric lights.

VIRGINIA, ILL.—Virginia Electric Light and Water Company has been incorporated; capital stock, $50,000. To furnish light, heat and power. Incorporators, C. M. Hubbard, Matt Yaple, L. A. Peterfield and J. A. Jones.

SHEBOYGAN, WIS.—The Sheboygan Light, Power and Railway Company has been incorporated. The incorporators are J. M. Saemann, George B. Mattoon and I. Saemann. The capital is $20,000.

BASTROP, TEX.—An electric light plant is to be established.

PLAINFIELD, ILL.—Plainfield Electric Light and Power Company has been incorporated; capital stock, $4,500. Incorporators, Giles D. Foster, A. E. Mottinger, U. S. B. Blakely.

New Electric Railways.

CUMMINSVILLE, OHIO.—A company is to be formed to construct an electric street railroad from Cumminsville to Mt. Airy. The company is to be composed of citizens of Green and Colerain townships and property owners along the proposed line and vicinity. The capital stock will be $100,000.

CLEVELAND, OHIO.—It is stated that a project is on foot, with Hon. Tom. L. Johnson as its chief promoter, to connect Cleveland and Toledo by an electric railway.

ALBANY, N. Y.—The Greenwich & Schuylerville Railroad, with a capital of $300,000, has been incorporated to construct and operate a six-mile surface electric railroad from Greenwich, Washington County, to Schuylerville, Saratoga County. Directors are: Watson N. Sprague, Robert Hamilton, Greenwich; Reeves Smith, Martin Schenck, Troy; James Mealey, James E. Kelley, Schuylerville; Alben M. Crandell, Middlefalls; Thomas W. Cantwell, William J. Wilson, Albany. It is understood that United States Senator Edward Murphy, Jr., is back of Mr. Wilson.

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